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AVIATION AND COSMONAUTICS

No 2, February 1989

AF CIC Reviews Evolution of Soviet Air Force

91441175a Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 1-3

[Article by Mar Avn A. Yefimov, Commander in Chief of the Air Forces: "Aviators of the Revolution: 1918-1989"]

[Text] The year 1918 had begun. Defense of the revolution had become a most critical issue. The young Soviet Russia was faced with thousands of problems of enormous complexity. Factories and transportation were idle, and there was a shortage of fuel and grain. The country had been laid waste by destructive forces. All this was to be subdued to the unified will of the builders of a new society. But first of all it was necessary to crush the counterrevolution and create a battleworthy army.

The party of Lenin had made its choice. And it was necessary that, in a country exhausted by the imperialist war, each citizen also make his choice.

The worker class, the peasantry, and the soldier masses responded to the appeal of the Bolsheviks. The Red Army was established in February 1918. The annals of defense of the socialist homeland begin in that time. Impassioned and sorrowful, heroic and tragic pages. But the Soviet citizen's faithfulness to the homeland and selflessness in battle have remained unchanged.

The history of the Red Air Force is complex and unique. The uniqueness of the forming of Soviet combat aviation lies in the very nature of our branch of service.

Aviation has always been a domain of complicated machines, formidable scientific and professional knowledge, and a high degree of technical sophisticaltion. And this means that the bulk of flight personnel in prerevolutionary Russia were officers, members of privileged social strata. The values and ideals of the military aviators, their world view, their moral code, ways and customs did not easily blend with an army which had risen up in defense of the interests of the working people.

Class bonds were severed, while clans and professional societies collapsed.

A new world was being born. The new age demanded new ethics.

Hundreds of aviators of the old army joined their personal destiny with the destiny of the homeland. And they made a choice: they marched into combat on the side of the revolutionary masses. Pilots I. Pavlov, P. Mezheraup, A. Stepanov, I. Spatarel, A. Sergeyev, A. Labrents, G. Sapozhnikov, Yu. Bratolyubov, and B. Chukhnovskiy.... They could not conceive of life without a vital bond with Russia. They trained flight personnel and fought the White Guard with valor. The proletarian elements of Russian military aviation—enlisted personnel, airframe and engine mechanics—totally accepted the revolutionary war. Many of them became pilots.

A great many aviator-internationalists also came to the aid of the Soviet Republic.

The Red Air Force was short of a great many items: airplanes, engines, spare parts, fuel, and ordnance. In spite of the fact that as far back as the beginning of the 20th century Russian aeronautical engineers had declared their creative talents to the entire world, Russia's aircraft industry was inferior to that of the leading European countries and the United States. During the imperialist war military aviation was provided combat equipment chiefly through delivery from abroad. The Entente sought to ensure that their Russian ally was as dependent as possible on its foreign imperialist partners.

Now, in 1918, every salient factor was taken into account. Military aviation was employed in the most critical combat sectors. Everything was centralized and concentrated. Red Army military pilots performed those missions which most closely conformed to their actual capabilities. Air reconnaissance, engagement of White Guard cavalry, bombing of military transport movements, strikes on bridges and river-crossing sites, air-to-air combat, coordination with naval forces, agitation activities, liaison and communications services—Soviet military aviation performed all the missions.

A total of 300-350 aircraft were in service at any given time. A total of more than 20,000 combat sorties were flown, more than 84,000 kilograms of bombs were dropped, 144 air-to-air engagements were fought, and 20 kills were scored.... Perhaps such figures are not very impressive from the mere standpoint of numbers alone. But how much courage stands behind each number, how much daring behind each sortie!

Military aviation was second to none from the very first days of the Soviet Armed Forces: the aviators of October were always morally superior to the enemy. This was the case in February 1918, it was the case in the difficult, conflict-filled 1930's, and it was true in the terrible 1940's.

The great and tragic 1930's....

The unprecedented soaring flight of aeronautical engineering thought. The brilliant solving of thousands of seemingly unsolvable industrial problems. The innovativeness and great skill of flight personnel. No sacrifice for the homeland is too great. Everything was done to the glory of the Soviet people and socialism.

And the rampant wave of unjustified repression during those same years. Thousands of military aviators passed through the prisons and camps. Many were executed. And not only people were destroyed. New ideas and new views on the role of aviation in war were destroyed as

well. New operational-tactical concepts were scrapped from the arsenal of the Air Forces if they failed to be in conformity with the notions of the nature of combat operations on the part of those who had usurped the right to the truth of combat. But nevertheless the human factor of our military aviation stood firm, refusing to break.

The terrible 1940's....

Soviet military aviators met the fascist aggression honorably, at first armed with selfless filial willingness to defend the homeland, soon thereafter fully armed with combat skill, and subsequently equipped with excellent combat hardware as well. They advanced from the unparalleled heroism of June 1941 to operational-level air superiority on the most decisive battle fronts in the period from December 1941 to April 1943. They advanced through strategic air supremacy, achieved in the battles in the spring of 1943, to final victory in May 1945. Of course history of the Air Forces, just as any history, contains facts, events, and the fates and destinies of individuals. But that is not the extent of it. History also is the spirit of a time, and the most important thing is the existence and reality of the person who takes part in and makes history. The conclusion is unequivocal on this criterion as well: our military aviators were always worthy of the mission assigned to them by their fellow countrymen.

What is the character of today's military aviator? What problems pertaining to the human factor must be resolved today in order to accomplish the entire aggregate of Air Force missions?

And these tasks—combat readiness, a high degree of professionalism, and flight operations safety—are traditional only in a first approximation. The present-day world situation, the revolution in science and technology, and the forward evolution of military aviation affairs are constantly changing the content of Air Forces life and times.

The USSR's defensive doctrine fosters stabilization of international relations. But at the same time it does not simplify the system of cobmat training but makes the entire system more complex. It excludes an extensive path of strengthening defense capability and shifts the development of Armed Forces combat potential to accomplishment by improving qualitative parameters. But this means a different content to combat training, another system of tactical exercises, more flexible and dynamic organization and maintaining of combat readiness.

Fourth-generation military aircraft advance an entire new aggregate of problems. It is no easy matter fully to master their combat capabilities. Working within the new structure of the Air Forces and fundamental change in the flight personnel training program also represent pioneer ground in large measure, requiring inquiry, analysis, and synthesis.

And this is far from a complete list of difficulties, but perhaps just the principal, most substantial and important ones. But even the enumerated items confirm the need to search for new, intensive modes of functioning of the main component in the Air Forces—the human factor. Are we always able truly and properly to involve the human operator in the processes of military affairs?

We shall probably not get too far in gaining knowledge of the human factor in combat aviation if we bashfully skirt (in the interests of so-called modesty) the fundamental uniqueness of the flying profession. This question must be addressed, not in order to elevate artificially but solely in order to restore the truth, without which a great deal is distorted.

The principal uniqueness of the flying profession, from which all else derives, is the fact of operating out of contact with the ground, in an unaccustomed living and working environment. The time scale within the framework of which one must evaluate what is taking place and produce behavioral reactions is quite "unnatural." There is a forced rhythm of activity, as well as a great many adverse factors: pressure changes, G loads, vibrations, and a confined working and operating position. One is constantly close to danger. And this is only an extremely rough "portrait" of the flying profession.

There are also many unusual elements in the activities of technical personnel. An aircraft is a very large aggregate of parts, assemblies, and components. Nevertheless it is the aircraft technician [crew chief] who approves release of the aircraft for flight operations. He guarantees that everything will operate flawlessly. Is this your ordinary garden-variety courage?

Thus the human factor in the Air Forces is a complex, unique factor. The 20th century is very rapidly making what were recently miracles into everyday accomplishments. But this is the external countenance of progress. That which has become accustomed and routine to mankind is not always such for those who every day are professionally engaged in an uncommonplace activity. For this reason aviation is for mankind as a whole only one area of rapidly advancing technology, while for airmen aviation will always be a miracle embodied in metal and electronics, which has lost neither its fascination, its complexity, its fullness of spirit, nor its perpetual newness.

But what qualities are paramount for today's aviator? They are quite numerous. We shall list the most important ones, proceeding from the present-day situation: competence, responsibility, and innovativeness. Without these elements we shall be unable to take a single step forward in combat readiness, skill, or flight safety.

Competence. Comprehensive, thorough, across-the-board. From knowledge of theory to the ability to control one's own emotional and psychological state. From the ability to predict possible combat actions to totally coordinated procedures in operating aircraft

equipment. From skills in making precise tactical calculations to well-developed combat intuition. Yes, the flying profession is a synthetic phenomenon.

The competence of the military aviator is formed by the entire system of his multifaceted training. But let us turn to a very specific question: how should one prepare for flight operations? It would seem that we possess a vast store of experience in this area, amassed over a great many years. But can we assume that all matters are clear in this area?

Just what is the narrow, pragmatic goal of training and preparation for flight operations? To provide a person with everything he needs to function effectively in the "pilot-aircraft-environment" system. But how does a person function in this highly complex system? What are the working mechanisms of a pilot's consciousness? How do natural reflexes and intellectual reactions to the flight situation link together into an integral, purposeful work motion?

An important question arises: does the adopted concept of training and preparation for flight operations correspond to the actual process of in-flight activity? How accurately are we able to simulate and model on the ground that environment which awaits the pilot aloft? There is certainly plenty for scientists, commanders, and pilots to think about.

One might reply that, after all, every day thousands of pilots take to the air. And they fly without any special supermodern notions of flying activity. Yes, they fly, they have flown, and they will continue flying in the future. But how effectively are we using the human factor? Is the current length of flight service by flight personnel acceptable? Is the presently-achieved level of flight safety satisfactory? And then there is what perhaps is the most troubling question: what will tomorrow bring?

Thus the particular grows into a rather general problem. And how many of these particular items are there? But one should not be surprised at this increase in the number of items opened up for future inquiry. We are living in conditions of a revolutionary renewal, and consequently the significance of man is increasing to a greater extent than ever before. Competence is a mandatory attribute of any job. And in every job competence is specific, concrete, focused rigorously and precisely. Incompetence is the bane of our times. The incompetent is always the inept and unskilled. Such a person has no chance of satisfaction from a well-performed job. And he seeks substitutes, surrogates to his human destiny.

Of course competence is a result of the entire existing system of training. But the aviator himself is unquestionably the most influential factor in this process.

Responsibility. It is sometimes presented in an excessively simplified manner! Degree of responsibility is linked with level of job position. But that is not the case. Job position determines the extent of job duties and the content of work duties. It may specify organizational, executory, command, narrowly specialized, and indoctrinational elements. It may confirm the predominant work style and method. But how frequently higher-echelon commanders, seeking to expand their authority, automatically remove responsibility from their subordinates. The effectiveness of any job is sharply diminished, in spite of a conscientious endeavor by all to work in an honest and upright manner. Results prove to be incommensurate with expended energy. And the primary cause is distortion of responsiblity.

Let us address some practical examples, such as combat readiness. It is accepted practice to evaluate a regiment's combat readiness. And this means that the entirety of responsibility is placed on the shoulders of the corresponding command personnel. The pilot is automatically absolved from responsibility, as it were, for his own personal continuous combat readiness, while the crew chief is absolved of responsiblity for the continuous operational readiness of the combat aircraft entrusted to his care.

The shortsighted commander relegates to his junior (in position) comrades the role of insignificant unit, of a "little person," and these latter readily consent to this role, because it is not only of modest dimensions but also comfortable, placid, and safe.

But the "little man" is a type of eras past; he is not of our time. The human factor in full development is in conformity with the main task of the contemporary stage of revolutionary renewal. It is more difficult for commanders to work with such an individual. And daily work and living are also more difficult and stressful for the airman himself. But at the same time this is the only acceptable type of individual in the Armed Forces today.

But how is responsibility formed and shaped? Primarily by the habit of disciplined behavior. And in connection with this I should like once again to draw attention to the essence of our military discipline. Unfortunately very frequently people see in it primarily the element of coercion and restriction of individuality, and yet this is a misapprehension. The purpose of Soviet societal and military discipline is to ensure an optimal interlinkage of individuals in complex collective activity. And especially where the situation is frequently conflictive, ambiguous, where it becomes necessary to resolve a conflict, sometimes a very acute conflict, between the extent and complexity of a job and the limited nature of available combat resources with the only available force—orders brooking no compromise.

There is also another aspect of discipline in the modern manner. It has become appreciably more complex as a principle of interaction of individuals performing a joint task. It contains increasingly less room for formalistic command and unthinking submission. When the human factor is restricted by all kinds of bureaucratic guidelines, it is not difficult to achieve absolute discipline. But this is only an appearance of strong fusion of individual and military duty.

A genuine, stable bond arises when a commander assigns a task to his subordinate and finds a reasonable combination of generality and detail in an issued order; when there is no unnecessary and unproductive prescription of every step in a subordinate's future activity; when there is room for applying the experience and innovativeness, intellectual and volitional abilities of the individual carrying out the task. If everything is defined in advance, a task assigned by one's superior remains alien to the subordinate. He may clearly understand the task, but it remains alien.

To command means to organize and ensure conditions of executability of tasks assigned to subordinates. It is very difficult today to command. If commanders have not mastered modern scientific methods of command and control, they cannot arouse an insuperable sense of responsibility in the executing personnel. Nor will there be any genuine success.

In combat a commander imposes authority on the individual with his order. But the individual himself nevertheless determines the main issues of life and death. The final choice is up to him. And we know quite well that the Soviet airman will always make the correct choice. And in the process of combat training as well one must certainly count precisely on this factor, for otherwise, instead of integral discipline for the serviceman, the result may be something unexpected and unconstructive: confusion, nervousness, and lack of responsibility.

And finally we come to creative endeavor and innovativeness. One can have various attitudes toward this state, toward such an obligation, toward this right. It can be viewed as a boon bestowed by one's superior, and it can be viewed as one of the most essential conditions for normal professional activity.

Are even two absolutely identical flights even conceivable? Can anybody claim that in combat some one situation in all its details will be repeated on several occasions? The conclusion to be drawn is quite simple. Creativity and innovation in the process of combat training is not a pleasant flight of intellectual fancy but rather a mandatory attribute of the military aviator's profession. There are more than enough proof-providing arguments. We shall cite the most eloquent of these.

Any technical modernization advances a number of highly complicated problems. When the Sidewinder missile became operational, for example, there was a sharply increased danger of taking a hit from the first missile launched. If the adversary got behind your wingline, he was close to a kill. All tactics grounded on cannon and machinegun fire instantly collapsed. Air-to-air combat became a battle for superiority in the rear hemisphere, although it is true that at the time it involved a comparatively narrow segment of the rear hemisphere. Extensive adoption of radar in controlling pilots in combat ushered in a new era in the art of combat. Diversified tactical elements appeared. Support activities became commensurate with direct combat action. The next Sidewinder upgrade (increase in seeker aspect angle and allowable G load at launch) made it necessary to devise totally new tactics.

The development of electronic warfare technology, all-aspect missiles, and increase in weapons range resulted not simply in certain changes but produced a totally new combat environment. Air-force tactics have gone through fundamental changes at least 5 times since the 1960's, and this represents an immense amount of work! Development of new combat documents and new principles and modes of air-to-air combat corresponding to the synthesis of all combat factors. The search for specific tactical devices and moves. Radical restructuring of the system of combat operations command and control.

New tactics immediately demand qualitative improvement of the entire complex forming the basis of the military aviation domain: flying technique, flight training methods, and system for ensuring flight safety.

What are the specific features of today's combat aircraft of the potential adversary? The main technical trend is toward precision munitions and highly-accurate weapons. In formal terms this is merely an increase in effectiveness of fire, but in practical terms it means a genuine revolution in combat employment of air forces: the scrapping of general concepts and particular ideas, and transformation of the main formulas for fighting combat engagements.

What was the air-to-air combat formula applied during the Great Patriotic War? "Altitude-speed-maneuver-fire." The development of high thrust-to-weight ratio supersonic aircraft required an adjustment to this formula. The key to victory was expressed in the following postulate: "Speed-altitude-maneuver-fire." And what about today? The following algorithm probably best expresses the general trend of modern-day air combat: "Information-space-maneuver-fire." Even this algorithm does not yet represent the final truth. The truth will be revealed by simulated-combat training and a number of tactical air exercises. Nor will this truth be eternal, but merely an episode in the history of the Air Forces.

Any undertaking presupposes creative endeavor. Modern military aviation, due to its multiple-variant nature, is fundamentally impossible without innovation and creative endeavor.

Competence, responsibility, and innovation.... These are the prime attributes of the human factor in combat aviation. But why is it given so much attention? Is there cause to doubt it, reason for acute concern? No! The flight personnel of our homeland's Air Forces are reliable. But our most inexhaustible reserve potential lies precisely in the human operator. With creation of favorable conditions for development and improvement of the qualities of the fighting man who has adopted the moral, ethical, and professional traditions of those who flew the Red Air Force's first airplanes, defending the

homeland against the enemy. A fighting man who carried the spiritual and intellectual potential of the Soviet aviator through all the tragic and magnificent ordeals and adversities, who always achieved the victory our country needed. Since 1918....

And we stand on this foundation today as well!

Improvements in Political Indoctrination Classes Noted

91441175b Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 4-5

[Article, published under the heading "Problems of Training and Indoctrination," by Col V. Kirsanov, senior instructor, Air Forces Political Directorate: "Method Is the Key to Knowledge"]

[Text] **The learning process should be grounded on a problems approach, dialogue, comparison of differing points of view, debate, and other active forms of group discussion.**

From the Basic Directions of Restructuring the System of Worker Political and Economics Education.

* * *

Perestroyka, the livening of sociopolitical thinking, and people's heightened receptivity to the events and processes currently taking place in Soviet society and the USSR Armed Forces are objectively strengthening the role of political instruction and are increasingly more distinctly and claerly demanding its qualitative upgrading. The officer corps is a leading category and main bearer of ideological-political potential, scientific and technical advance, and combat readiness. Due and proper attention is logically devoted to ideological conditioning of the officer corps in the Air Forces.

In the Air Force units in which officers V. Shenshin, G. Pechkarev, S. Filatov, B. Kirilyuk, and A. Kvasha serve, Marxist-Leninist training is increasingly becoming that domain of activity in which political thinking is being openly honed, one's social attitudes are being formed and shaped, actions and deeds are politically evaluated, and moral-ethical issues and problems of mutual relations are being raised. At the same time, however, the inertia of the old thinking and actions is still strong in a good many units.

The main path toward creating an atmosphere of openness, glasnost, free exchange of opinions, and quest for the truth lies in progressive methodology. A sequential and consistent transition to the problems approach method of conducting officer Marxist-Leninist training classes is being carried out today in Air Forces units under the guidance of political agencies. Experience in employing this method in the units in which officers P. Fedorov and G. Pechkarev deal with this problem enables one to discuss its future promise and considerable potential.

Those who have mastered the problems-approach method of instruction include Col V. Solovyev, an experienced volunteer propagandist with many years of experience in leading a Marxist-Leninist training group. He works continuously and persistently to develop in his students an endeavor to increase their level of political knowledgeability and a striving toward independent analysis of the situations they encounter in their daily lives, and he teaches them the ability to determine the correct political position in each specific instance.

In conducting classes, Vladimir Borisovich encountered the situation where a given point might be a problem point with one group but not with another group. This required that he analyze the students' level of knowledge and more thoroughly study their personal qualities, personality and character. There are 16 Air Forces personnel in his group. Half are CPSU members, and one quarter of the group have in the past been enrolled in universities of Marxism-Leninism. All officers are engineers, graduates of military and civilian school, who possess various degrees of work experience and military service experience, who possess differing professional and military training and levels of proficiency, and who are of various ages. As a result that which is simple and understandable to one is difficult and constitutes a problem for another.

The instructor resolves this objective conflict, typical of all military collectives, with a skilled combination of work with the entire group, separate subgroups, and individuals. He classifies the lesson material and breaks it down into related units, some of which are understandable to all, while others require more detailed discussion within the group, and still others are scheduled for more thorough coverage in the course of subsequent independent study. This differentiated approach makes instruction classes interesting for all and enables students with differing level of training to display their knowledge and abilities, to reveal their weak points, as well as to learn to do work of a research nature.

With a problems-approach lecture presentation, the propagandist does not simply state scientific conclusions to his students but shows the path which led him to these conclusions. Reasoning aloud, he reveals contradictions, advances suppositions, substantiates them, and refutes possible objections. In the final analysis he approaches the truth with the aid of a system of logical proof and facts, leading his students to the truth in the process. The students, following his reasoning attentively and with interest, become involved in this process of inquiry, reason together with the class instructor, and become participants in the intellectual process.

The experience of V. Solovyev and his comrades officers A. Ivanov, V. Boyarskiy, and L. Yevsyuk convince one that presentation of a class topic can be effective only

when the propagandist thinks through in advance the method he will use to present the material and state the problems. Initiallly he gives a formulation of a specific point and presents proof of that thesis. He then points to and comments on facts, phenomena, and events which objectively seem not to fit into the given thesis and system of proof and may even be in contradiction to or conflict with them. After this he invites the students to engage in joint inquiry to obtain a logical agreement or discrepancy between the formulated and proven thesis and the indicated contradictions, proceeding from this to formulation of a final conclusion.

Practical experience indicates that such a structure of presentation of the instructional material is perceived well, because it contains not only a declaration of truth but also includes proof, as well as opposing factors. Such a statement of the problem induces group or individual search for the truth and in the final analysis leads to the conviction that it is knowable in its unity and contradictory elements. This conviction does not come immediately, it is true. The fact is that the consciousness of some individuals is still capive to old notions and dogmas. Unfortunately they have become disaccustomed to thinking independently and having their own, distinct opinions. Another significant factor manifested here is a fear of appearing ridiculous, as well as the fear of becoming the target of abusive shouting and railing, the fear of making an incautious remark, the fear of derision from their comrades over their unusual way of thinking, and fear of stating things right out. In short this is a difficult, but today very necessary thing.

In the opinion of Lt Col V. Solovyev, the possibilities of the problems-approach method of instruction are most fully realized in seminar classes. First and foremost he has rejected the unoriginal scheme of textbook (basic outline)-seminar response-performance evaluation. This approach engendered the fear of receiving a mark of unsatisfactory, killed interest in the class, excessively simplified the instructional process and frequently boiled it down to verifying whether or not a student was in possession of outline notes. Vladimir Borisovich feels that the seminar is not so much a means and form of testing knowledge as it is a unique laboratory in which officers acquire and develop skills in independent, innovative analysis of sociopolitical and economic problems and learn to debate and apply their acquired knowledge in a practical manner.

Solovyev feels that problem situations arise during instruction classes only as a result of statement of issues the formulation of which does not presuppose a simple and unequivocal answer, which evokes in the students a situation of intellectual difficulty, and demands intensity of thought and independent effort in order to arrive at a correct solution.

The debate or discussion is the culmination of student creative activity at a seminar session. When working through the method of organizing and conducting the discussion, the volunteer propagandist proceeds from the following fundamental consideration: first of all, the discussion should involve key items for the given topic, but should not address random or secondary items. Secondly, the debate or discussion is the highest expression of the problems-approach method. It should not exclude other forms and techniques of conducting a seminar but only supplement them in an appropriate manner, occupying a greater or smaller share within the arsenal of methodological means.

When organizing classes using this methodology, the instructor outlines a rough list of topic items on which to hold the discussion, with the aim of achieving more thorough assimilation of certain fundamental points of the topic under discussion. He notes down discussion items for each of the principal seminar problems. At a seminar class on the topic "Armed defense of socialism—a historical necessity," for example, in examining the item "V. I. Lenin and the CPSU on the aggressive nature of imperialism," the instructor specified the problem for discussion, utilizing the Leninist thesis: "...There are just wars and unjust wars, progressive and reactionary wars, wars of vanguard classes and wars of backward classes, wars which serve to consolidate class oppression and wars which serve to topple it." He instructed his students to discuss and analyze the historical conditions from which a given war proceeded, what classes conducted this war, and for what purpose.

In preparing for a seminar and the conduct of a seminar discussion, Vladimir Borisovich proceeds from the position that presenting the problem to the students is only half of the job. The next stage is proper organization of its discussion and resolution. As a preliminary he refines and details formulations and official appraisals, formulates logical-problem assignments on the basis of contemporary and historical material, and reasons through situations of selection of final solutions. As practical experience indicates, this preliminary work by the instructor is extremely important.

As we know, one type of independent study assignment is the preparation of summary-type papers, which sometimes are incorrectly interpreted as completed replies to assigned items. In Solovyev's opinion selection of a subject for such a paper and statement of the problem to be addressed constitute creation of the problem situation, which is resolved in subsequent discussion or debate. Group members Majs N. Tkachenko and R. Myakotnykh approach working on papers precisely in this manner.

Selection and preparation of reference literature for informational briefing purposes, excerpts from the writings of the founders of Marxism-Leninism, party documents, monographs clarifying various points of theory and terms and dealing with semantic, political, historical, and moral aspects of the issue is another type of study assignment. The group instructor is convinced that technical means and use of supplementary material and imaginative literature are indispensable with the problems-approach method of instruction.

Every class conducted by party member Solovyev constitutes not only the next step toward cognition but also a graphic lesson of pedagogic skill. Tactfulness, kindness, and the ability attentively to hear out a reply, to ask an additional question in a prompt and timely manner, and to guide the debate in the proper direction foster an uninhibited exchange of views, form and shape the level of sophistication of the discussions and debates. All this brings innovativeness to a seminar class and induces the students to think, analyze, compare, and synthesize. And it is not surprising that in this group they have advanced from reading outline notes to independent, uninhibited presentation of material. As a result the officers have greater interest in theory, the process of cognition, in history of the Communist Party and the Soviet State, and in seeking solutions to acute political and social problems. Classes are distinguished by breadth of the items addressed, including problems of glasnost, democratization, nationalities and military policy, and by liveliness of discussion and debate. Thus what is taking place is the process of forming and shaping of new political thinking on the foundation of a Marxist-Leninist understanding of dialectics and using genuine, current materials.

The end result of political instruction is also manifested in increased responsibility on the part of personnel for the results of their labor. Lieutenant Colonel Solovyev and the majority of his men are characterized by a sense of the new and progressive, job-related and sociopolitical activeness, and civic maturity. More than half of the officers and warrant officers receive marks of excellent in combat and political training. Last year they adopted 14 efficiency innovator suggestions. And the innovators continue to be active. The unit is now close to solving the difficult problem of adoption of sensing devices employing new physical principles and advances in modern microelectronics.

But the main achievement is a healthy political and ethical attitude in the men, an atmosphere of mutual demandingness, readiness and willingness to come to one another's assistance at a difficult moment, the ability to solve large and complex problems, and a focus on the end results of their military labor, promoting increased vigilance and combat readiness.

Flight Commander Discusses Deplorable Air Mishap Statistics

91441175c Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 6-7

[Article, published under the heading "Flight Safety and the Human Factor," by Military Pilot 1st Class Maj I. Petrakov, flight commander, delegate to the 19th All-Union CPSU Conference: "An Integrated Approach Is Needed"]

[Text] "A real paradox!" the young pilot said to his comrades. "The requirements of the documents which spell out our work duties are strict and quite unambiguous. Each and every word in these documents has been put to the practical test. But nevertheless near-mishap incidents and air mishaps have occurred in the past and are continuing to occur. It's like fate...."

Many of the pilots did not share the lieutenant's opinion. A great deal of what he said was open to debate. For example, his outright statement about the unambiguousness, coordinated and reconciled nature of the requirements of guideline documents. I believe that many will agree with me that one would have a devil of a time wading through the flood of documents received by the regiment. Or take his view that air mishaps and mishap-threatening situations are inevitable. Is this statement not subject to debate? After all, we have a great many mishap-free units.

Incidentally, the point is not the no-uncertain-terms nature of the lieutenant's opinions, which is typical of young people. The ensuing debate impelled me to consider the question of who is right. I recalled an article entitled "Order Yourself" (AVIATSIYA I KOSMONAVTIKA, No 1, 1989). I am totally in agreement with the author that such powerful factors as honor, conscience, dignity, and pride in being a member of the Air Forces are having little effect on improving flight safety.

Indeed, why is it that the various orders, directives, and instructions have not yet become, figuratively speaking, that filter which would protect flight operations from accidents? Musing over this question, I reached the following conclusion, for the umpteenth time: first and foremost because their execution is not always organizationally reinforced in an intelligent manner at the local level. We have become infantile, as it were, as if we were not human beings but mere inanimate cogs in the vast military aviation system, a point which was argued to us over the course of many years. And as a result, due to a lack of organization locally, the leadership role of the central echelon, from which come recommendations on the conduct of preventive measures, is sometimes carried out according to the principle of "bandaid medicine." In my opinion this is one of the main reasons for many of our problems.

And yet here is what is surprising: one cannot say that people are doing nothing at all at the unit and subunit level. Just take, for example, the squadron in which I serve. Last year a great number of measures aimed at improving flight safety were carried out just on the basis of the party buro schedule. Party meetings were held with the following agenda: "Progress in restructuring party work in light of the demands of the 27th CPSU Congress and subsequent party Central Committee plenums"; "On the state of party buro work and measures to improve quality of aircraft maintenance"; "Party organization tasks pertaining to further strengthening party influence on matters dealing with combat training, improving quality of training exercise performance and observance of safety measures at training exercises," plus others.

Keynote speakers party members B. Sevastyanov, L. Gladkov, and A. Zhukov leveled plenty of criticism at shortcomings and attempted to show the way to correct them. Party members Yu. Yakimenko, V. Kuznetsov, V. Novikov, A. Cherevko and others who took part in the ensuing debates arrived at the following conclusion one way or another: in military aviation there should be no place for blind chance and the notorious "Lord willing and the creek don't rise." Can we allow our people to be ruled by chance, and with the consequent element of lack of discipline or lack of initiative on the part of certain individuals?

Such a form of working with party members as the accountability report on performance of one's job-related and party duty pertaining to increasing flight safety has also taken hold in our party organization. Party members officers A. Gerasimov, G. Malyshev, Ya. Vereshchenskiy and others were given performance evaluations. These comrades' opinion is unequivocal: such reports help look at one's performance from a different vantage point, as it were, helping one evaluate one's moral countenance and job proficiency.

Our work has borne fruit. The flight safety situation in the squadron has improved. Logged flight time per in-flight incident has increased threefold (from 60 to 175 hours). But nevertheless....

Eleven mishap-threatening incidents have been recorded in the subunit. The parties involved include flight commanders Yu. Yakimenko, I. Chikov (two each), and A. Gerasimov, senior pilots V. Geynrikh, who is rated 1st Class, V. Blagodarov, V. Gadalev, V. Sidorov (2nd Class), and V. Romanovich (3rd Class). As we can see, 1st class pilots account for 50 percent of the incidents, while flight commanders account for 40 percent.

Sr Lt V. Gadalev was in high spirits as he took off. He accomplished the flight to the range flawlessly, quickly found his target, and squeezed the ordnance-release button, but nothing happened. After the pilot returned from this training sortie, it was ascertained that the aircraft cockpit had been poorly preflighted.

As he took off, flight commander Capt A. Gerasimov had a precise picture of the flight configuration of his training sortie. He incorrectly distributed his attention, however, in manipulating the cockpit equipment. As a result he was late in changing his wing sweep angle, which resulted in exceeding the maximum allowable airspeed for the current wing sweep angle position.

The two-ship fighter-bomber element stood poised on the runway. When the pilots commenced their takeoff roll, the aircraft piloted by wingman Sr Lt D. Petrov began rapidly overtaking the element leader, flight commander Capt Yu. Yakimenko. It turns out that Yakimenko was taking off with afterburners at low setting, while Petrov was using full afterburners. This resulted in a difficult in-air situation.

The pilots prepared thoroughly for the tactical air exercise. They laid out and computed their route, mission profile, and target strike maneuver. They completed their preparations with a pre-mission rehearsal involving "walking it through" [air combat with models]. It seemed that they had taken every tiny detail into account. While attacking the target, however, the two-ship element led by Capt V. Geynrikh approached dangerously close to the lead pair. Why did this happen? The strike was set up on the basis of visual contact between the aircraft pairs, but diminished visibility threw them a curve.

The party buro held the violators of procedures strictly to account. Party members G. Malyshev, I. Chikov, M. Pavlov, and A. Gerasimov were charged with negligent procedures. Party members V. Romanovich, A. Blagodarov, V. Sidorov, and Yu. Yakimenko presented reports on their personal contribution toward strengthening flight safety. In short the subunit party organization responded immediately to deficiencies in combat training. One would feel that, as party buro secretary, I might feel a sense of satisfaction. But I was unable to shake my feeling of concern, and here is why.

The cited mishap-threatening situations of course contain their own specific technical features. If one evaluates them in the traditional manner (as was the case), one can state that they were a consequence of basic negligence and a poor sense of responsibility on the part of flight personnel. Perhaps that is so, but nobody deliberately does something to his own detriment! When we take off on a sortie, each of us wants to return alive and well. This means that there are also other causal factors behind mishap-threatening situations: moral-psychological factors. Do we take them into account? The fact is we do not, since we are amateurs in this domain.

Pilot error is frequently viewed as a technical system fault resulting from violation of operating procedures. But a combat pilot is a human being! He is alive, and he does not function according to a loaded program—either at home, in the flight operations preliminary preparation classroom, or in the air. In my opinion this means that a mishap or near-mishap incident should be analyzed first of all from the psychological point of view, and only subsequently from the technical standpoint. I am convinced that as long as we continue attributing everything to lack of discipline, carelessness, negligence, and lack of proficiency on the part of flight personnel, we shall not achieve any appreciable improvement in flight safety. What we need is a combined approach to solving this problem of national importance.

But at the present time we are attempting to solve it proceeding from what we have at our disposal in an intellectual, moral-ethical, and technical respect. Leader-Communists and party buro members regularly hold accident-prevention interviews with personnel on

quality of preparation for flight operations, on knowledge of the appropriate documents, etc. In general we still follow the old criterion: quantity rather than quality of actions.

Some new things have been added. Work by the party buro with subunit supervisor personnel has been stepped up. It is true that at the present time we are only taking very timid steps in this direction. Lack of experience is a factor. In addition, this is a rather delicate business. Nevertheless we have supervisor personnel present performance reports to the party buro, and we grade their performance of job-related and party duty. They present various briefing reports at party meetings. In particular, one party buro meeting was devoted to performance results by squadron supervisory personnel pertaining to restructuring of management and administrative activities. This made it possible in some measure to close the circle of mutual responsibility: commander-subordinates, subordinates-commander.

We are gradually eliminating a lip-service approach in synthesis and dissemination of advanced know-how. For example, Military Pilot 1st Class Maj L. Buravtsev achieved our unit's highest results in combat flying. In talks with him we sought an answer to the question of where the sources of success lie.

Performance monitoring group specialists Capt S. Mitrofanov and WO V. Karadzhi prepared weapons sight data photographs and made copies of the most important flight performance record segments showing flight parameters during target attack. Individual schedules for improving flying skills were drawn up for each pilot taking into account analysis of these materials.

Results exceeded all expectations. Flight personnel responded enthusiastically to this innovation. This had an immediate effect on increasing flight personnel activeness. The tactical air exercise was drawing closer, and such a psychological and morale boost was absolutely essential. High performance results at the tactical air exercise offered confirmation of this.

I can state without fear of exaggeration that in this squadron adequate attention is being devoted to thoughtful utilization of data recorder tapes for preventing air mishaps and near-mishap incidents. We hold people strictly to account, no matter who they are, for failure to respond to what the data recorder tapes tell us. The data recorders placed on our aircraft provide tapes which enable instructors to determine not only errors but also their causes. Can one really ignore such information?

Things are worse as regards the problem of improving the method of training flight personnel. Or not even improvement, but precise execution of what we already have. Sr Lt M. Pavlov and officers G. Malyshev and I. Chikov were charged with liability for party disciplinary action for failure to observe the proper method of breaking-in and orientation for Pavlov following service-school graduation. Capt A. Cherevko and the author of this article were held personally responsible for similar failures during breaking-in and orientation of Captain Romanovich.

While in no way playing down the culpability of the instructor personnel, I would like to say that these shortcomings also were a consequence of the fact that we lacked adequate experience and know-how in training young flight personnel. The fact is that up until quite recently all pilots in the squadron had 1st-class ratings. This naturally placed a certain imprint on our activities. But then young pilots arrived, and we found ourselves in a somewhat difficult situation. I am saying this in order to make clear that not only the entire collective but each individual instructor must work in advance with replacement personnel.

Unfortunately we still encounter frequent violations of proper procedure in readying aircraft for flight operations. Aviation engineer service specialist personnel A. Kravchenko, V. Palgov, and V. Novikov were subjected to party disciplinary action for this. In spite of the fact that the party buro did numerous things to improve the situation, no qualitative changes occurred here either in surmounting the problems cropping up in daily activities or in implementing the specified programs. And in my opinion the blame lies chiefly on the shoulders of squadron deputy commander for aviation engineer service Maj L. Mishin. The party organization severely criticized his performance. A deadline for correcting deficiencies was specified.

What are the boundaries of responsibility? Where is that line beyond which the unpredictable in our activities commences, when chance begins to hold sway? It is difficult to give an unequivocal answer. One thing is clear at the very least: air mishaps cannot be eliminated until lack of organization is conquered at all levels.

Afghanistan Exploits of Heroic Hip Pilot Related

91441175d Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 14-15

[Article, published under the heading "They Were Decorated by the Homeland," by Col Ye. Besschetnov: "Matter of Honor"]

[Text] **Helicopter section commander party member Capt N. Maydanov has joined the magnificent group of Soviet pilots who have received our homeland's highest decoration. He performed his internationalist duty during two tours in the Republic of Afghanistan. For courage and valor displayed in the skies over this country, Nikolay Sainovich was awarded the Order of the Red Star, the Order for Service to the Homeland in the USSR Armed Forces, 3rd Class, and the Order of the Red Banner. In 1988 this officer was awarded the Order of Lenin and the Hero of the Soviet Union Gold Star Medal.**

The following article tells how N. Maydanov reached the heights of military valor.

* * *

Sr Lt N. Maydanov gazed intently through the windscreen of the Mi-8 at the green fields of Baghlan province sweeping past below him. The highway snaked back and forth across the green expanse. "Where are our tanks?" the troubled thought kept repeating.

Half an hour back the combined-arms commander had briefed the helicopter crewmen on the situation. The dushman [mujahideen], retreating into the mountains, were offering desperate resistance to the Afghan forces and Soviet subunits supporting them. As they were entering a kishlak [village], our tank column came under fire from recoilless guns positioned behind a strongly-fortified duval [hut].

"We would bring rocket artillery fire onto the mujahideen gun crews, but we cannot: they are right next to the village. Innocent civilians would suffer. There is only one solution: hit them from the air.... Can you do it?" The commanding officer looked hopefully at the airmen.

"We'll do our best," section commander Capt Petr Romanenko assured him and turned to Maydanov: "What do you think, can we do it?"

Everybody knew that section navigation officer Nikolay Maydanov was an outstanding bombardier.

"Of course! It is a matter of honor...."

The two-ship element took to the air. It was a clear, sunny day. Flanked by mountains, the green fields spread out below them. Finally they saw out ahead a stretched-out tank column, and a bit further on, beyond a curve, that miserable hut.

"Let's first fly a non-firing pass, to take a look at things," Maydanov suggested to the section commander.

The latter agreed. Nikolay quickly figured wind force, velocity and direction and dialed in the necessary bombsight corrections.

The next pass was a live run on the target. Maydanov leaned over the bombsight eyepiece tube. He focused all his physical and mental energy on one thing: to aim precisely and to release his bombs accurately. The target drew ever closer.... Bombs away! The automatic bomb release system actuated, and the bombs, released from their shackles, headed toward the ground in a curved trajectory. Capt V. Karpov's crew, following the lead helicopter in, checked the bombing accuracy. "You got 'em!" the wingman radioed.

The bombs had hit smack on the target, blowing the hut to smithereens and hitting the mujahideen recoilless gun crews. The tanks could proceed.

Nikolay Sainovich was born in 1956, in the village of Tuskuduk, Ural Oblast. It seemed he was destined from birth to be an internationalist. His father, Sain Saingaliyevich, was a Kazakh, while his mother, Galina Lyudvigovna, was Ukrainian on her mother's side and German on her father's side. And the Maydanovs had lived their entire lives among Kazakhs, Russians, Ukrainians, and Koreans. Nikolay had been taught from childhood to respect people of other nationalities. He married a girl from the neighborhood, Tatyana, a Korean.

Upon graduating from secondary school, Nikolay went to work at a brickyard, and in the evenings took driver courses offered by the local DOSAAF organization. Upon completing driver training, he worked for some time as a truck driver.

His dream of flying stayed with him, however. Serving his compulsory term of military service with the Group of Soviet Forces in Germany, shortly before discharge Maydanov passed the entrance exams for a military aviation school for pilots with a field examining board. He was sent to Saratov.

The four hard years of study passed swiftly. He became a commissioned lieutenant and an engineer-pilot. Nikolay Sainovich began his officer career with the Southern Group of Forces.

Lieutenants Vyacheslav Ofitserov, Vladimir Lipenkov, and Nikolay Maydanov, fresh graduates of the Saratov Higher Military Aviation School for Pilots, were made right-seaters in an Mi-6. But Nikolay wanted to fly the Mi-8. His friends soon accepted their fate, but he submitted one written request after another. He did not give up when his requests were denied. Three years later, when Lt Col G. Muzhikov assumed command of the regiment, he submitted another request, and this time was successful.

Maydanov thoroughly mastered the Mi-8 and his duties as copilot-navigator. He was soon sent on a tour of duty to Afghanistan.

He was assigned to the Afghan air base at which V. Pismennyy and N. Kovalev served—pilots who subsequently were awarded the homeland's highest decoration. He knew them well and saw with what courage and valor they carried out combat missions. This made an imprint on his character and inspired him to selfless endeavor.

Maydanov flew more than 250 combat missions in Afghanistan. He was awarded the Order of the Red Star for his military deeds.

Upon his return home, Nikolay Sainovich was assigned to a helicopter regiment in the Red-Banner Odessa Military District. He was promoted to left-seater. He took part in tactical air exercises. The experience he had gained in combat certainly came in handy! He showed himself to be a mature, proficient combat pilot.

That same year Maydanov was reassigned to the Transbaikal. Here Nikolay was reunited with his former unit

commanding officer, Col G. Muzhikov, and his old schoolmates Vyacheslav Ofitserov and Vladimir Lipenkov. They did not serve together long, however. As soon as he was promoted to senior pilot and captain, there once again arose a need for a tour of duty in Afghanistan. Maydanov submitted a formal request.

This time Maydanov was based in the southern part of the country. The missions were about the same as before: delivering various supplies, hauling sick and wounded, flying in assault elements, and inspection of caravans. The men in Nikolay Sainovich's squadron considered him lucky. His sorties very often produced considerable results.

...To the northeast of the squadron's base, up in the mountains, there was a so-called "kotlovan" [flat or depressed area surrounded by hills or mountains]. It was close by air, about 15 minutes, but the aircrews preferred to give it a wide berth. But for some reason Maydanov was attracted to this "kotlovan." Once he went to the squadron commander: "Comrade Lieutenant Colonel, request permission to head over that way. We'll fly an inspection pass and see whether there are any caravans."

The squadron commander hesitated.

"I've thought it all out. First of all we'll make only one flight up there. Secondly, we'll utilize the element of surprise: we'll head out early in the morning. Let's just suppose that a caravan crosses the border and makes a day's halt there, and here we are...."

The CO weighed his arguments and approved the request, but added: "You always luck out, Maydanov! I will approve the flight, but don't ask for trouble. The mujahideen up there have pretty strong air defense. They'll knock you out of the sky."

Just at sunrise a four-ship element (a pair of Mi-8s and a pair of Mi-24s), led by Captain Maydanov, took off and headed toward the "kotlovan." They crossed a low range of mountains and literally five minutes later encountered an enormous caravan stretching out a distance of about 3 kilometers. The camels, laden with crates, were resting on the ground. Small groups of armed mujahideen were sitting calmly nearby. It was obvious that they were not expecting any helicopters to appear. They immediately scattered as soon as they spotted the rotorcraft, but some attempted to deliver defensive fire.

Maydanov and his wingman had already swept past. A kilometer back the pair of Mi-24s, led by Maj A. Skvortsov, was moving up. Maydanov radioed: "Andrey, adjust heading left. There is a caravan, a military caravan, positive ID. Swing right in and hit them."

Skvortsov's element immediately attacked, sweeping along the length of the caravan. A minute later they swung around on a second attack pass. With the Hinds covering, Maydanov and his wingman swooped in and landed. They quickly disgorged their air assault troopers, practically right on top of the caravan, and in such a manner as to prevent the mujahideen from heading for the hills.

While the Mi-24 crews hit the bandits from the air and the assault troops hit them from the ground, firing from behind boulders, Maydanov and his wingman headed off to a landing site adjacent to motorized rifle troops, to pick up reinforcements. En route they reported back to the squadron on the firefight in progress in the "kotlovan."

They arrived at the landing site, took about 20 troops aboard, and returned to the "kotlovan." By that time one of our troops was gravely wounded. Maydanov took him aboard and immediately headed out for a military hospital. By this time four-ship gunship elements were approaching the battle site.

Part of the caravan security force had been killed, and the rest lay down their arms. The helicopters proceeded to haul off the captured supplies and eqipment. There was so much that they had to fly practically right up until dark. The Afghan leadership expressed thanks to the Soviet airmen for destroying this large muhahideen caravan.

This was not an exceptional incident in Nikolay Sainovich's Afghanistan experience. His crew encountered difficult situations fairly often. Although Maydanov was only a senior pilot at the time, the command authorities had no hesitation about having him lead helicopter elements. And he did a fine job. Such was also the case on 8 December 1987.

On that day Captain Maydanov, in a two-ship element with Capt Yu. Kuznetsov, was on search-and-rescue alert status. They were scrambled on an emergency call. They landed at a motorized rifle unit landing site, took aboard an assault element, and took off, at which time the squadron commander radioed: "We're sending you a section of gunships to fly cover. Position one pair out ahead, and the other to your rear. Proceed as the situation requires."

As they were approaching the destination, they were informed by radio that a troop-lift helicopter which had arrived ahead of them had been shot down and the assault element it had delivered was now surrounded. The Mi-24 pair flying out ahead immediately engaged, forcing the hard-pressing mujahideen to break off their attack on the air assault troopers.

"011, fierce fighting in progress here," Maydanov heard the lead aircraft's radioed report. "A great many weapon positions. They are firing from everywhere."

When they arrived at the site they saw that one helicopter had burned up and another, which had tried to rescue the air assault element, had been shot down on takeoff. Our people had taken shelter in a shallow depression near the helicopter. As soon as Maydanov put

down the reinforcing element, the mujahideen proceeded to "pen in" the helicopter with mortar rounds. The pilot of the downed helicopter waved them off, as if telling them to get out before they got shot down.

Maydanov took off, while the Mi-24s continued hitting the mujahideen weapon positions.

"01," Maydanov radioed Kabul. "Situation bad. Our force is encircled. Requests help. It's got to be extracted out of there. Under very heavy fire."

"We're arranging help. Aircraft will be coming—to be under your control. In the meantime you're on your own...."

Establishing radio contact with Capt Yu. Kuznetsov, who was following behind him, Maydanov radioed: "We're going in for a landing. I'll go first. You wait for the present."

He swooped in and landed. The mujahideen immediately intensified their fire. It was a good thing that the Mi-24s still had ammunition. Their crews provided solid covering fire for Maydanov's helicopter. Nikolay Sainovich took about 10 troopers aboard and took off. Kuznetsov then went in and landed at his command and took aboard the rest of the assault troopers. The rescued troops were transported to a safe area, about 5 or 6 kilometers across the grassland, where they set up a perimeter defense in anticipation of subsequent assistance.

They still had to pick up the assault element which Maydanov had put down as reinforcement. This element was situated a kilometer to the east. They already had some seriously-wounded troopers.

"012," Maydanov radioed his wingman. "You orbit here with the Hinds. I'm going in...."

At this moment Maj A. Skvortsov, who was leading a helicopter gunship element, radioed: "011, ammunition exhausted, heading back...."

They then received a radio message from the command post that a section of Mi-8s and a section of Mi-24s were on the way.

"Roger," Maydanov replied. "Return to base." He then added: "We still have to extract the assault element. There are 12 men here."

The first pass. Maydanov maintained heading, gradually diminishing his airspeed, but the volume of mujahideen fire kept increasing. Close shellbursts were alternately pitching the craft forward and tail down. Mortar rounds were falling out ahead, to the left, and to the right. They kept getting closer and closer, bursting quite close by....

It was too close for comfort: Nikolay Sainovich pushed the cyclic stick forward and got out of there.

He made another attempt, approaching from the other direction. The same story: the mortar round bursts were getting too close. He flew a third approach, and again was unsuccessful. On the fourth try he literally hugged the ground, keeping an eye on the approaching bursts. He made it through to the shallow depression where the air assault element had set up a perimeter defense. Mortar rounds burst nearby, and shell fragments showered above the helicopter.

The wounded were taken aboard, followed by the rest. The assault element leader, a young lieutenant who had taken a bullet through the lung, entered the cockpit. There was a blood froth on his lips. He reported: "The spooks are 200 meters from this position."

Instead of replying, Maydanov shouted: "Take a head count. Have we got them all?"

"One is missing. He is about 100 meters out on the right, holding the flank along the stream bed."

They were queried by radio from the command post: "Have you picked up the assault element? Get it off the ground."

"We have the element on board, but one man is missing."

A few minutes later came a stern command: "Take off. 01 has ordered that you take off immediately!"

"How can I take off? I am missing one man. If he is left here, they'll kill him. I'll take off only after I get him aboard...."

What could be done? Maydanov feverishly sought a solution to the problem.

"Valera," he turned to his copilot, Sr Lt V. Almakov. "I know I don't have the right to send you, particularly in this situation. But I must. Take one other man, get out there and look for him."

Almakov and an enlisted man took off down the hollow. About 3 minutes later they found the missing soldier. He was wounded in the arm, but he was continuing to cover the right flank, to prevent the mujahideen from penetrating across the takeoff path. Essentially the lad was deliberately sacrificing himself in order to save the helicopter and everybody on board. He ran up, out of breath, and said to Maydanov: "Don't take off in this direction, sir. The spooks are straddling your takeoff path."

Maydanov swung the helicopter around. He commenced a takeoff downwind. Clouds of dust roiled up, obscuring everything. It was very difficult to take off, particularly from the terrain depression. The helicopter picked up airspeed. Suddenly the Mi-24s, which had just arrived on the scene, shouted over the radio: "Break, break, Nikolay! Mortar rounds! Mortar rounds!"

He was well aware of the mortar shells. They were being dropped ahead of him and to both sides; the helicopter would take a hit any minute, but he also realized that he

could not turn until he had accelerated to the required airspeed—he might stall out. As soon as the needle crept past the 100 mark, he put the helicopter into a bank and streaked toward safety.

01 flew in to visit the squadron the following day. He spoke with the rescued motorized riflemen, with the helicopter crews which had taken part in the combat engagement, and determined the details of the situation in which Maydanov's crew had been operating. Even he, a combat veteran, marveled at the courage displayed by this officer.

"Maydanov is a man of unusual daring and boldness," the squadron commander told him. "The majority of large mujahideen caravans have been taken by elements led by Nikolay Sainovich."

Capt N. Maydanov served in Afghanistan eight more months after this, and flew approximately 200 difficult combat missions. At the end of May 1988 he finally returned home, to his Transbaikal garrison.

Section commander Nikolay Sainovich Maydanov is passing on his combat experience and know-how to his comrades. He enjoys great respect in the regiment. Additional accomplishments in military labor and in service to the homeland undoubtedly await Hero of the Soviet Union Capt N. Maydanov.

Simple Aircrew Radiation Dose Calculator Described

91441175e Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) p 18

[Article, published under the heading "Innovators at Work," by Lt Col A. Khalin, senior engineer, Air Forces Office of Inventions and Efficiency Innovation: "Accomplished Quickly"]

[Text] A high degree of vigilance, continuous combat readiness, and the capability to perform combat missions in conditions of enemy employment of weapons of mass destruction have become particularly important in present-day conditions. It is possible that in combat air subunits and units will be forced to operate in zones of NBC contamination. Continuous reconnaissance, situation assessment, and correct choice of modes of action in complex situations are the most important measures to ensure protection.

The "Radiation situation aloft quick estimate and forecast calculator" will be very helpful to the Air Force commander in making an optimal decision in the air or on the ground pertaining to penetrating (bypassing) radioactively contaminated airspace in order to maintain the fighting fitness of aircrews, assault troops and the personnel of airlifted subunits.

Employment of this device, devised by Lt Col L. Moskalenko, a senior instructor at the Military Air Academy imeni Yu. A. Gagarin, will make it possible not only significantly to shorten the time required to make the required calculations but will also provide capability to solve several attendant problems simultaneously.

It consists of a two-sided measuring grid with an inner movable scale. The design incorporates the principle of combining a number of parameters. It is this which ensures virtually instantaneous problem solution. The device is simple to use. It can be used for all airspeeds and altitudes of modern fixed-wing and rotary-wing aircraft.

One can determine the following with this calculator: base and top of mushroom clouds formed by nuclear airbursts and surface bursts; average and maximum radiation dose; radius of probable contamination zone with single nuclear airbursts and surface bursts. By setting with the inner moving scale the time which has passed since the nuclear burst, mean wind velocity, and other data, one can determine the total average radiation dose in the case of multiple nuclear bursts within a limited area; radiation doses received by an aircrew during flight above the area of a nuclear surface burst and in a fallout zone at low altitudes; time following a nuclear burst after which a crew, flying through a radioactive cloud, will not receive a radiation dose in excess of the specified standard.

The calculator is fairly simple in design. Squadron and unit handimen can make such a device. It can be very helpful to aircrews, especially in the course of a tactical air exercise. Of course a full evaluation of the radiation situation is performed by commanders and staffs. All personnel of air subunits and units, however, should be able to perform simple calculations, especially personnel tasked with performing CBR reconnaissance. Employment of this device will help personnel work more effectively on mock combat missions pertaining to protection against weapons of mass destruction and will help personnel perform with confidence at tactical air exercises in conditions of "radioactive contamination."

AF Command Center ATC Operations, Working Conditions Described

91441175f Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 18-20

[Article, published under the heading "Following a Policy of Perestroyka," by Col A. Dmitrichenkov: "Days and Nights at the Command Center"]

[Text] **The air traffic control center was noisy: telephones were ringing incessantly, and fans were humming. From time to time the ATC controllers would radio queries, receive reports, and issue instructions.... A duty shift was in full swing!**

The Command Center is an executive agency of the commander in chief of the Air Forces. Its area of responsibility is enormous. Its most important tasks include organization and coordination of air traffic, as well as flight safety. There are also a great many other tasks, for in the Air Forces any time is a busy time.

Even a cursory glance is enough to see that the Command Center specialist personnel are working at maximum stress, although around-the-clock duty is routine here.

* * *

I remember that day early last December. News of the earthquake in Armenia cascaded suddenly, like a mudslide, into Soviet homes. Nobody was left indifferent to the tragedy. People from all over the world responded to the disaster. Military aviators were among the first to come to the aid of the victims. The disaster areas became for them a genuine battle front. Dozens of airplanes and helicopters headed for the earthquake area on that very first day.

During those days when efforts were in progress to save thousands of human lives, the "peak" load fell on the shoulders of Command Center specialist personnel. They were working 30 hours or more without sleep or rest. The newspapers, radio and television reported their selfless labor time and again, listing the names of those officers who did a particularly outstanding job. Implementing the decisions of the command authorities, they stoically exercised command and control of various air subunits.

When news of the disaster arrived, the Command Center chief, Maj Gen Avn L. Chervyakov, assessing the situation, decided to increase duty shift personnel. This is standard practice. When things get difficult, responsibility is assumed by the most highly-proficient specialist personnel. On this occasion the "leader" slots were taken by party members officers V. Nazarov, V. Kachanov, V. Fedorov, V. Alekseyev, and A. Zhuravlev. Commander Center supervisor personnel remained on duty around the clock.

One can judge by the chronicle of events how the Command Center specialist personnel handled the job. That first day they controlled about 100 aircraft. But by 12 December more than 300 An-124s, Il-76s, An-22s, and An-12s were operating. In view of the busy schedule of arrivals and departures at Yerevan's Zvartnots Airport, each day there would only be a small "window" available for the departure of helicopters carrying members of the CPSU Central Committee Politburo commission. And the Command Center specialist personnel were handling with precision the steadily growing air traffic flow.

The alarm sounded in the mountains of Armenia was heard throughout the world. The most favorable time of day—between 1000 and 1800 hours—was allocated to foreign aircrews. Our military transport aviation operated during the night, in the morning and at dusk. Men with a strong sense of military duty, acknowledged professionals—Lt Cols V. Ovchinnikov, P. Trushin, V. Molokin, and N. Ivanov—manned the duty shifts, working with the aircrews. They handled their duties brilliantly.

Over the course of many days and nights the job of keeping the airways wide open for assistance to the Armenian people was performed in an exemplary fashion. An important element in this was the fact that Command Center specialists established in a prompt and timely manner and efficiently maintained direct communications not only with Air Force commanders in the various parts of the country but also with a number of ministries and agencies: the Ministry of Civil Aviation, Ministry of Foreign Affairs, Committee for State Security, and the Main Customs Administration....

Working conditions were extremely difficult. Calculations were performed swiftly. Sometimes mental sharpness and experience were the only things helping one get out of truly impasse situations, especially during those first days. One must bear in mind that the airports at Yerevan and Leninakan have relatively limited traffic capacity. Leninakan, for example, could accommodate only from six to eight Il-76 aircraft. If each has a turnaround time of 3 hours, for example, only 50 flights a day are possible. But the Air Forces would have up to 200 departure-ready aircraft. What could be done in such a difficult situation? No such questions were articulated at the time. Only solutions were proposed. The most optimal solutions were implemented. In this instance emergency measures were taken to speed up the process of unloading aircraft. As a result we were able to run an additional 30 flights. They also began unloading aircraft at airfields of the Transcaucasus Military District and in Tbilisi, from where supplies would be transported by truck.

Command Center personnel worked hard and intensely. Sliding timetables and flight operations schedules drawn up "like in combat".... Mutual assistance saved the day at difficult moments. People did not leave their station until they were absolutely sure that they had completed their part of the job. The Command Center chief was able to get only six hours of rest in the first 72 hours. Col V. Kachanov and Lt Col V. Glukhov both worked two sectors simultaneously. They also helped others. Maj A. Chetverushkin, Glukhov's assistant, perfomed his duties with particular fervor. Although ill, he would not leave his work station.

When you consider the airmen's unparalleled emotional enthusiasm, their military and political awareness, you come to the strong conclusion that it was not merely military duty which was guiding them. There were also indications of something more. "It was as if these people got a second wind," commented Col Gen Avn L. Batekhin, Military Council member and chief of the Air Forces Political Directorate, who devoted close attention to the activities of the Command Center specialists during those days. "This came from the men themselves.

They were motivated to this by perestroyka, glasnost, and democratization throughout our society. And people became genuine 'iron men' in the face of all life's ordeals."

Today the Command Center is back to normal. All subunits are performing their principal function. But the intensity of work activities is not diminishing, for alert duty is never easy. The specialist personnel are aware of the fact that enhancement of the role of qualitative parameters in military affairs presupposes further increase in the vigilance and combat readiness of Air Forces units and subunits and improvement of all aspects of military life

On what is this grounded? First and foremost on personal responsiblity on the part of each individual for performance of his duties.

The Command Center party committee took upon itself to resolve an important problem—activation of the human factor. An emotion-charged discussion was conducted at a party report and election meeting. The keenness of the discussion was in large measure predetermined by a report presented by party committee secretary Col N. Osipov. It was not your run-of-the-mill accountability report but rather a presentation of reflections and taking counsel with party members on how to conduct perestroyka more effectively.

To act innovatively, without excessively close supervision or doing a subordinate's job for him means, as was noted by those who spoke during the discussion, opening up opportunities for initiative. Already last year trivial job duties were done away with in the Command Center subunits, the number of meetings was sharply reduced, and main efforts were concentrated on working directly with personnel. The party committee gave the party organizations independence in handling day-to-day problems, but at the same time demanded results. Things of this kind are no rarity in the collective. They graphically show that people respond promptly to positive changes.

Take, for example, the method of conduct of alert duty within the air defense system. Somebody dubbed it the "full work load" method, and the author of this method, Col V. Danilchenko, does not object to this title. The method incorporates clear and precise specification of what each individual should be doing each hour and each minute.

The timeliness of this innovation is obvious. It is high time to make maximum use of the potential of the Command Center. The inadequate effectiveness of former methods of responding to airspace intrusions, putting Air Forces alert assets into action, and analysis of command and control facility operating teams and subordinate command facilities have long been a matter of concern to the collective. It has been necessary to make major adjustments in operations.

Adoption of the new and progressive frequently takes place in struggle against old, obsolete notions and requires unconventional solutions. But there exist already today sufficient arguments in favor of this method. A comparison of current with past performance convinces us that it has proven its effectiveness. The specialized proficiency of personnel has increased significantly. Means of automated command and control are being utilized more fully. The list of documents articulating formal rules and regulations pertaining to the operations of alert-duty personnel has been changed and reduced. Specialist personnel have been given greater freedom to display initiative and innovativeness. Today people are more concerned not with performance evaluations as such but rather with how genuine forward movement can be accomplished in operational proficiency. An uncompromising attitude toward unnecessary situation simplification and unnecessary relaxation of demands is becoming the norm here.

Priority emphasis in operational training at the Command Center is indisputable. Personnel live by the rules of maximum responsibility. There can be no secondary items when it is a matter of national defense: neither personal work style, nor failure of a single training activity, nor leniency toward any violator of military discipline. This approach is being firmly established in all subunits without exception.

Certain facts, however, indicate that violations of alert-duty discipline are still occurring. For example, traffic movements by groups of fixed-wing and rotary-wing aircraft are not always quickly and efficiency ATC-serviced. Not all specialist personnel possess sufficiently thorough mastery of air traffic control facilities and equipment.

I feel that subunit party organizations and the party committee should adopt a firmer and franker position. They can help improve things if they more aggressively foster and promote everything that is focused toward seeking new ways of intensifying the training process, toward bringing it closer to conditions of actual combat, and hold more strictly to account those who attempt to accomplish new tasks with obsolete methods.

It is important to intensify party attention toward inquiry efforts in those areas where equipment is not fully up to today's requirements. It is one thing to wait for centralized supply and delivery of equipment and quite another thing to do something with one's own manpower and resources. It is essential to respond immediately and in an efficient manner to problems which arise in the course of combat training, to provide reliable control of fourth-generation aircraft, and to develop material and technical capabilities in a purposeful manner, focusing on local specific features and needs.

Within the Command Center collective there are problems which have existed for years. One of these is the fact that duty personnel work stations are not properly

equipped. Many specialists have spoken up particularly sharply on this score, including Col V. Suvorov, Lt Col G. Kapustin, and others. Practical realities demand that we provide normal working conditions for duty Air Forces personnel. People are on duty for a period of 24 hours or more, and they become tired. They bear an enormous responsibility. There is no way to relieve the psychological stresses.

Work is presently being completed on renovation of the Command Center's main operations area. I believe that this will significantly improve working conditions.

There is no point in looking for malicious intent on somebody's part as regards existing problems. One contributing factor is evidently the attention focus on more important items being handled by the collective. But that does not make things any easier on people. Demands on specialist personnel are sharply increasing, both from the higher and lower echelons. At this point we should also note how much supervisors lose in the eyes of their subordinates when their statements about people's needs find no concrete embodiment.

The fact is that today a great deal is changing for the better in the subunits of the Command Center. Things are far from being fully satisfactory, however. In view of today's psychological stresses, tightly-packed air traffic schedules, and qualitative change in aircraft systems, specialist personnel can and should work not only fully utilizing automation and electronic equipment but also should be working in a more comfortable environment. This will promote further increase in the vigilance and combat readiness of Command Center personnel. Duty personnel will produce more reliable performance around the clock.

Bear Bombers Fly Mock Intercept of 'Threat' at Sea

91441175g Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 21-23

[Article, published under the heading "Great Vigilance, Continuous Combat Readiness," by AVIATSIYA I KOSMONAVTIKA special correspondent S. Skrynnikov: "Masters of Long-Distance Flights"]

[Text] Our Tu-95 lifted off the runway and proceeded to climb skyward. I was observing the aircraft's crew, which was under the command of Military Pilot 1st Class Maj P. Potapov, and I was thinking about what an inexhaustible store of mental and physical energy they must possess in order selflessly to devote themselves to their duty. I recalled the events preceding our departure.

...Dusk settled gently over the airfield. A flight operations shift was coming to an end. The last pair of combat aircraft was on final approach when the assistant flight operations officer turned to Lt Col A. Shumskiy: "Sir, an An-12 is requesting permission to land at our field. His field is socked in."

"Fine, we'll take him," replied Aleksandr Sergeyevich, and then said to himself: "I'll greet the crew and go to supper with them."

The An-12 taxied to the ramp. When the props had come to a stop, a general emerged from the aircraft. Shumskiy introduced himself and then said: "I invite you all to the officers' mess. We'll have supper and some nice hot tea."

"I believe, comrade lieutenant colonel, things are going to be hot for us right now without any tea," the general replied, handing Shumskiy an envelope. He added: "This is an operation order for you. Open it immediately!"

"Pretty sly on their part, getting permission to land at our field on a phony excuse," Shumskiy thought to himself as he took the envelope.

Time had compressed into a taut spring and had assumed particular value. Henceforth a minute meant several tenths of a nautical mile covered by a naval surface "threat" toward the Soviet coast. And a good many minutes were needed to top off the fuel tanks, which were practically dry following today's training flight, to check the engines and equipment, to obtain target designation data, and to plot a route.

Once again the field, which had been about to settle down for the night, came back to life and swung into feverish action. The pumps fired up, transferring fuel from tank trucks to aircraft. The flight would be out to full combat radius, meaning that every liter of fuel would count.

Missiles were readied and trundled out to the aircraft. In spite of the fact that they had to do the job with reduced personnel, the ground technicians did the job quickly and, most important, with excellent quality. They realized the possible cost of any malfunction at a moment when, let us say, the bomber would be out over the ocean.

The weather specialists, headed by Maj V. Mashinskiy, quickly provided details on weather around the base and en route. Technical company commander Capt O. Dubikov, deputy platoon leader Sgt A. Charents, and other airfield technical support battalion specialist personnel worked quickly and efficienty. Nobody had to be urged on.

In the meantime, in the flight operations briefing room pilots and navigators were listening closely to a situation briefing by the regimental commander and the regimental senior navigation officer. Every tiny detail was taken into account. Once airborne, there would be no opportunity to ask additional questions or obtain more details: they would be maintaining radio silence.

The commander's plan was formulated and adopted. Henceforth it constituted an operations order, which had to be executed at all costs.

Each crew was assigned a specific mission. Departure was drawing closer. Preliminary navigator calculations were completed, and the pilots and navigators proceeded to lay out the route. Firmly memorizing each and every river bend, projecting bit of shoreline, and every islet, the airmen "proceeded" across the enormous map, simultaneously converging at the little flag marked "target." At that point I said to myself: the mission must be a difficult one, since they are planning execution so meticulously, even though time is of the essence.

Soon aircraft and crews were reported ready. Performance standard met! Time to launch aircraft!

...We were flying around a deep low-pressure system. This meant new corrections to the navigation calculations: taking into account headwinds and route change. Everything in order to reach the designated point precisely and in a timely manner.

We were not the only ones heading toward the target. Somewhere out in that immense sky the crews commanded by Lt Cols V. Grunin and V. Volodin and Majs M. Prokhorov and A. Ashmarin were proceeding with equal determination. A fighter escort force stood ready to provide us air cover at a moment's notice.

The men had plenty of work to do. Take Maj A. Ashmarin's crew. The navigator, squadron deputy commander for political affairs Capt P. Schastlivtsev, and the assistant navigator, Sr Lt I. Bezobrazov, were deftly manipulating their navigation gear. Senior gunner-radio operator WO V. Fedorenko was intently scanning airspace and monitoring the radio. Aircraft commander Military Pilot 1st Class Maj A. Ashmarin and his copilot, crew party group organizer M. Butskoy, handled the heavy aircraft with skilled assurance.

It is not easy to stand up under the tension of a flight lasting several hours. Only morally toughened, thoroughly trained individuals are capable of performing so well.

It was time.... They were above their checkpoint! Execute turn! The aircraft turned to their final target heading. The distant target appeared as a blip on the airborne radar. The most critical moment had arrived. Just a little longer.... Get it lined up just a little more accurately.... Missile away!

The trip home always seems shorter, although it is frequently no less difficult. Once again they encountered headwinds, and once again they had to alter their route, flying around the low-pressure area, which had drifted southward. Finally the lights of their home field were in sight.

The aircraft shot their landing approach one after the other. The difficult flight was over. Photos and data recorder tapes confirmed that all crews had successfully accomplished the mission.

While we waited for ground transportation to the base compound, the men began discussing how things were going in the regiment. Based on how I myself felt, I knew how tired the men were and how badly they wanted to get home, but they took enthusiastic part in the conversation. Each had his own opinion about problems with perestroyka and the motive forces propelling it.

"Work, work, and more work!" Political worker Military Navigator 1st Class officer G. Batin stated with conviction. "After all, perestroyka is first and foremost a change in attitude toward labor, which is today becoming more creative and innovative, with greater awareness. One's attitude toward others is also changing. We are seeking democratic forms of management of the collective, and we are endeavoring to resolve important issues as a group."

The others voiced support for what Gennadiy Nikolayevich had to say. They talked about difficulties encountered in the course of rooting out lip service and predictable pattern in flight training, and about increasing return on effort from each and every flight operations shift. The men felt not in words but in deeds the importance of strengthening discipline and organization.

The conversation gradually shifted from "celestial" to "terrestrial" problems, which are just as difficult to solve, since in this domain a great deal does not depend on the efforts of flight personnel. The notorious "residual principle" of meeting people's needs had left a deep imprint at this Air Force base as well. The nursery school and kindergarten were still too crowded to accept many of the children of military personnel. The base boiler facility had long since reached its capacity. This year they had by common efforts succeeded in bringing a new school into operation, since the old school was running on three shifts. Having provided heat to the new school, however, the airmen are forced to make do with lower temperatures in their living and working quarters. They have not yet come up with a way to get the men home promptly after a flight operations shift. It is also high time to improve mess facility operations.

The fact is that, just like a blanket which is too short, resources for providing proper living conditions are at the present time not capable of covering everything. Here as well the airmen, while not shrugging off their own responsibility, are not without reason hoping for assistance from the military district command authorities and for a changed attitude toward construction and quartering at Air Force bases.

In the meantime, as they say, people are not simply waiting for a change in the weather. They are doing a good deal on their own. In the past recreation opportunities for base personnel were limited essentially to two movie theaters. While now Komsomol members and other young people have established a Komsomol-youth center on a volunteer basis, and a literary club and amateur theater are in operation. Interesting musical entertainment evenings are held on a regular basis. And physical training enthusiasts have established sambo

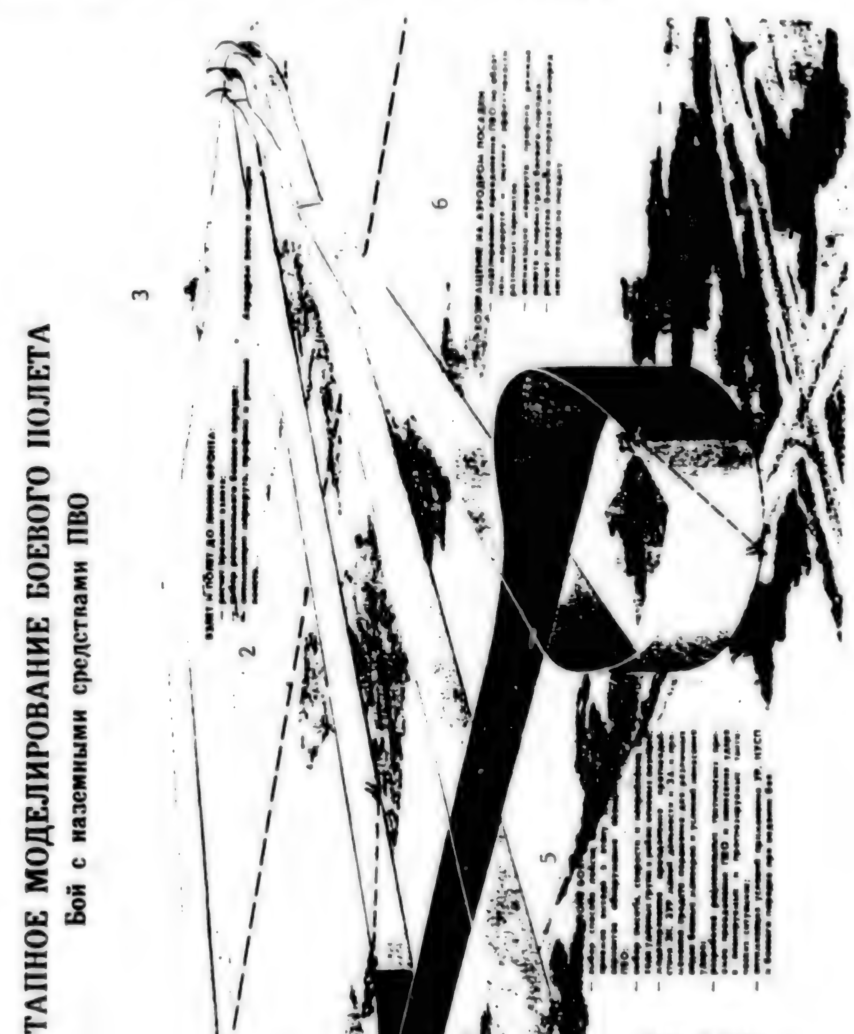
[Soviet unarmed combat martial art], hand-to-hand combat, and freestyle wrestling groups. Members of the sports groups perform Komsomol operations detachment duty, keeping things quiet and orderly at evening recreational activities and on the streets. The women's council has also begun taking more active part in base affairs.

...It was after midnight when we reached the base compound. In spite of the late hour, windows in the buildings were lit like beacons, promising comfort and rest. The next morning they would once again be readying for flight operations....

Air-to-Ground Mission to Hit Air Defense Assets Modeled

91441175h Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 24-25

[Annotated diagram: "Phase-by-Phase Modeling of Combat Mission: Engagement of Ground-Based Air Defense Assets"]



[Text]

Key:
1. FLOT
2. Departure and flight to FLOT: calculation of departure time; selection of appropriate formation; optimization of route, flight profile and configuration
3. Departure and destination field
4. Flight en route to engagement area:—prediction and analysis of deployment of hostile air defense assets along en route corridor;—modeling of penetration of hostile air defense and estimate of effectiveness of different variations;—optimization of route, flight profile, configuration, and formation parameters;—determination of points (areas) and procedure of jamming, type and parameters of missile-evasion maneuvers (maneuver to evade antiaircraft fire) for planned and predicted tactical situations.
5. Actions in engagement area:—selection of mode of target search and attack tactics for different variations of detection of air defense weapon position;—selection of altitude, speed and direction of penetration by strike elements into the fire position area;—modeling of getting past opposition by antiaircraft weapon systems, short-range surface-to-air missiles, and antiaircraft artillery, and weapons employment for various types of combat maneuvering and conditions of strike delivery;—devising of reasonable air defense penetration and strike delivery tactics in planned and predicted tactical situations;—optimization of conditions of employment of missiles, NUSP [expansion unknown], and formation during conduct of engagement.
6. Return to destination field:—modeling of air defense penetration on return route and estimate of effectiveness of different variations;—optimization of route, flight profile, configuration, and formation parameters;—calculation of breaking of formation and landing approach sequence.

Helicopter Airborne Crew Chiefs Perform Faulty Maintenance Procedures

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[Article, published under the heading "For a High Degree of Combat Readiness," by Capt S. Prokopenko: "School of Captain Zharkikh"]

[Text] It was growing light. The snow, which had been falling for almost a week now, had finally begun to taper off. The wind was driving clouds over the crests of the roundtop hills ringing the airfield. "If the weather clears up, things will be easier for Popov," Capt A. Zharkikh said to himself. He was as concerned as if he himself rather than the young crew chief [flight technician] would be facing a difficult proficiency test.

He remembered a certain post-flight critique and analysis session. When Lieutenant Popov was named as the guilty party in a near-mishap incident, the classroom fell silent and all eyes turned to flight technician-instructor Captain Zharkikh. And although the commanding officer did not direct a single word of criticism toward him, Aleksandr Mikhaylovich felt embarrassed, for he was the one who had certified the young specialist for regular flight operations.

What had happened? Essentially the young officer was done in, one might say, by excessive zeal. Heeding the advice of "veteran" crew chiefs, he proceeded on his own to fine-adjust one of the aircraft's systems. He was of course impelled by the best motives, but this ill-conceived initiative led to an unpleasant situation. The misadjustment became evident during flight, and the crew was forced to abort its combat training sortie and return to base.

After the post-flight critique and analysis, Captain Zharkikh went up to Popov.

"How did you happen to do that, Mikhail? Procedures are spelled out in detail in the shop manual. In any case you could have checked with me...."

"It seemed a trivial matter and that I could handle it myself," Popov replied, seeking to justify his actions.

"Trivial matter".... A troubling word. How many times must one repeat that there are no trivial matters in aviation? He was about to fire off this trite phrase, but refrained from doing so, seeking to cool his emotions. He realized that the problem could not be resolved with a dashing cavalry charge.

He carefully analyzed the crew chief's mistake and the quality of the work being done by other young specialist personnel. He reached an unexpected conclusion. It seems that most of them had "stumbled" in the performance of simple procedures.

He recalled his own early development. "After all, I made that same mistake," the captain admitted to himself. It was perhaps in Afghanistan that he finally and irrevocably freed himself of a slightly cavalier attitude to the job.

Yes, in the course of carrying out his internationalist duty Zharkikh had seen through his own experience how important it is to possess thorough knowledge of the content of the technical documents which spell out helicopter maintenance procedures. Ignoring any item which seems trivial in the view of some individuals and dividing procedures into simple and complicated have never led to any good and have at times placed the accomplishment of combat missions in jeopardy and endangered the lives of crew members.

Aleksandr Mikhaylovich knew of cases where crew chiefs sometimes attempted on their own "to improve" servicing procedures on various system components. An especially bad situation occurred, in particular, with the exhaust shielding. It is simple in design and operation. Judging by all indications, Sr Lt N. Velichko tripped up on this item.

He is a hard working and conscientious maintenance specialist. He quickly masters many involved helicopter servicing and maintenance procedures. But on one occasion his self-assurance tripped him up. Relying on his own knowledge and failing to check the manual, Velichko made an eyeball adjustment of the exhaust shielding. During flight hot air from the exhaust stack entered the reduction gearing space. The automatic fire warning system instantly cut in. The fire warning light on the instrument panel lit up. The crew had to return to base.

Velichko shrugged his shoulders helplessly in response to the question of why he had failed to follow the simple procedures specified in the shop manual. If he had been working on a complex system, he certainly would have read through the maintenance procedure sequence in advance, but this was a trivial item....

This incident serves as a good lesson to the men. A group of preventive measures was conducted with the aviation engineer service personnel. Such an incident was never repeated. Training classes and drills were also held in the unit with which Captain Zharkikh is presently serving. Nevertheless he was not fully satisfied with them. He was troubled by the fact that the priceless know-how and experience he had acquired in the Republic of Afghanistan was not being utilized. He discussed this matter at a party meeting. He noted in particular that the existing system of exchange of experience and know-how at practical conferences was in large measure ineffective and of a lip-service nature.

What usually happens? Officers and warrant officers assemble, listen to "regular" speakers, and that is the end of things until the next such event. Zharkikh suggested organizing something in the way of a regular seminar, at which the most important and critical topics would be discussed.

The people in the unit reacted variously to this party member's suggestion: some considered it a waste of time, feeling that they aleady had more than enough to do, while others asserted that there were other, more important matters to address. In short, his suggestion got nowhere. A nice-sounding formula was incorporated into the party meeting resolution: improve, increase, intensify....

Essentially Aleksandr Mikhaylovich was prepared for such a turn of events. He realized that the social infantilism which had accumulated in people during the years of the period of stagnation could not be scattered with a single gesture. He therefore proceeded calmly but persistently to work toward implementation of his proposal. With the permission of squadron deputy commander for aviation engineer service Maj Yu. Shevchuk, who supported his idea, he organized training for the young crew chiefs. On several occasions he invited specialist personnel from other subunits to attend the classes. Things proceeded well. Soon the "Zharkikh school's" fame spread throughout the regiment.

The skeptics fell silent once and for all after the proficiency rating board gave high marks to the crew chiefs with whom Zharkikh had been working. Their instructor was awarded the proficiency rating classification military technician 1st class.

The examination did not run entirely smoothly, it is true.

"A helicopter can take off after having sustained such damage!" Aleksandr Mikhaylovich's words rang out like a statement by an impractical visionary or an aviation dilettante in the classroom in which the proficiency rating board was holding session.

A lieutenant colonel from district Air Forces headquarters raised his eyebrows in surprise. "But that is in violation of prescribed operating procedures!" he stated in a tone which brooked no contradiction.

"I agree," stated Zharkikh. "But the combat situation sometimes is such that one must take a risk.... The main thing is precise calculation and knowledge of the design characteristics and capabilities of one's equipment."

The board members were not yet aware at the time that Captain Zharkikh, who had logged hundreds of hours in the skies over Afghanistan, was making this statement on the basis of thorough analysis and study both of his own experience and that of his fellow soldiers.

...On that hot day his crew had been given the mission to put an air assault element down into a landing site of limited size. The helicopter's main rotor blade tips were damaged during landing, causing the craft to vibrate and shake. The crew inspected the damage. The pilot shook his head dejectedly: the manual required blade replacement in such cases. But where could new rotor blades be obtained? After all, they had landed in an area under dushman [mujahideen] control. It would be a shame to abandon the helicopter. The situation appeared hopeless. Reinspecting the blades, however, and having weighed all the pros and cons, Captain Zharkikh proposed that they take off with the damaged rotor blade tips.

At first the pilot had his doubts, making reference to the operating manual. But the crew chief argued that the helicopter could make it into the air with such damage. Aleksandr Mikhaylovich assumed full responsiblity.

At this point it is difficult to say what influenced the pilot's decision: the conviction with which Zharkikh argued his point, or the report from their wingman, who was providing air cover, that suspicious-looking groups

of individuals were moving toward the landing site. In any case, they took off in spite of the damage and made it back to base safely.

After glancing at the flight operations schedule, Captain Zharkikh left the flight operations briefing room. According to the schedule, the helicopter being flown by Lt M. Popov's crew should be landing about that time. They had been practicing rescue operations at sea, and a great deal on this training sortie depended on Mikhail.

The helicopter appeared from behind the hills and smoothly came in for a landing. After it had landed and taxied to the ramp, Captain Zharkikh noted that the regimental deputy commander was climbing out—he had gone along on this flight to check the crew's proficiency. As he was approaching the briefing shack, the field-grade officer spotted the flight technician-instructor and, correctly noting his concern, said reassuringly to him: "Everything is fine, Aleksandr Mikhaylovich. No adverse comment on the lieutenant's performance. Your school did its job...."

Zharkikh could not help but smile upon hearing this appraisal of his labor. It was difficult to conceal the instructor's feeling of pride in his student.

Soviet-French Soyuz TM-7 Mission Described

91441175j Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 28-30

[Article, published under the heading "Cooperation in Space," by Maj Ye. Zhuk, candidate of technical sciences, and Maj A. Sergatskov: "15th International...."]

[Text] The history of cooperation between the USSR and France in the peaceful conquest of space goes back 22 years. It began in June 1966, when an agreement between our two governments was signed. This agreement states that cooperation between our countries in the field of space exploration is in conformity with the spirit of traditional friendship between the Soviet and French peoples. The agreement specifies a number of areas of scientific investigation, a special role among which is assigned to preparation for and execution of joint Soviet-French manned space missions.

And now another page in this cooperation has been opened. On 26 November 1988, at 1850 hours Moscow time, the Soyuz TM-7 spacecraft lifted off the launch pad at the Baykonur space launch center, manned by a Soviet-French international crew consisting of mission commander A. Volkov, flight engineer S. Krikalev, and mission specialist Jean-Loup Chretien. French President Francois Mitterand visited the space launch center that day. Such keen interest in the Soviet-French manned mission attests to further development in relations between our countries, fosters the drawing together of our peoples, and is promoting normalization of the international climate.

The scientific research schedule of the second Soviet-French manned mission is both extensive and interesting. Before proceeding with discussion of this program, we should introduce the members of the primary and backup crews.

Heroes of the Soviet Union Pilot-Cosmonauts USSR A. Volkov, A. Viktorenko, and A. Serebrov and the first French cosmonaut, Jean-Loup Chretien, are well known both in this country and abroad. They have contributed glorious pages to the history of space exploration. But our readers are not very familiar with the other two crew members.

This is Sergey Konstantinovich Krikalev's first space flight. He was born in Leningrad on 27 August 1958. Upon completing studies in the machine-building faculty at Leningrad Mechanical Engineering Institute, he graduated as an engineer specializing in the design and manufacture of airborne and spaceborne vehicles. He was employed from 1981 at the design office at which he had received practical training during college and at which he had written his senior thesis.

Krikalev devoted much time and energy to developing and testing new hardware. He took part in working out cosmonaut flight control procedures and in drawing up cosmonaut mission procedures manuals. For example, a new docking approach techique devised jointly with other specialist personnel enabled cosmonauts V. Dzhanibekov and V. Savinykh to accomplish successful approach to and docking with the unmanned Salyut 7 space station in June 1985. Sergey Konstantinovich also took part in experiments involving the development of other operational methods.

We should note in addition that S. Krikalev is a master of sports in aerobatics and a USSR champion. He is qualified on the Yak-18A, Yak-50, Yak-52, and Yak-55 aircraft.

In the period 1985-1986 Sergey Konstantinovich went through the complete training course at the Cosmonaut Training Center imeni Yu. A. Gagarin. After passing examinations he was given the title of cosmonaut-researcher [mission specialist]. In February 1988 he was assigned as flight engineer to a Soviet-French crew.

Lt Col Michel Tognini, the backup for French cosmonaut Jean-Loup Chretien, was doing his first pre-mission training. He was born on 30 September 1949 in the town of Vincennes, near Paris. Michel Tognini is a military pilot by profession. From 1970 to 1974 he received training at Air Force school, fighter pilot school, and specialized fighter pilot school, and from 1981 to 1982 he attended a training course at test pilot school in England. He served with the Normandie-Niemen Squadron, and served 1979-1981 as commanding officer

of the French Air Force Tigre Squadron. He subsequently served as a test pilot and commander of a test pilot detachment. He qualified on jet aircraft of various types. He has logged 3,000 hours. He had been in our country from November 1986 and completed the full Soviet-French manned mission training course.

We should note that the crew commenced specific mission training in February 1988. At this time training drills on combined and specialized simulators, which enabled crew members to develop the requisite skills in operating spacecraft and space station systems and components, were an important means of preparing cosmonauts for a forthcoming mission.

A combined simulator, for example, makes it possible sequentially to master the operations and procedures of a mission phase by phase: prelaunch preparation; launch into orbit; orbital flight; orbital path adjustment; orbital space station docking approach, undocking and descent from orbit, that is, to rehearse the entire mission as a whole. Particular attention is devoted to ensuring crew safety both during autonomous space flight and as a component of the scientific research orbital complex. It is on the combined simulator that crew members master precision response in normal, abnormal, and emergency situations.

Specialized simulators are used for detailed practice and thorough mastery of the most complex and critical operations, such as docking approach, initial docking contact, and hard docking, as well as controlled descent from orbit.

Delivery of the requisite equipment and initial familiarization sessions under the guidance of French specialists constituted a distinctive feature odf training the Soviet-French crews to perform technical and biomedical experiments. Familiarization and training was subsequently conducted by Cosmonaut Training Center imeni Yu. A. Gagarin specialist personnel. Training sessions included almost the entire workday schedule aboard the orbital complex, which helped refine and detail a number of items pertaining to scheduling of experiments and determining technical support requirements. All this enabled the cosmonauts to perform scientific research aboard the Mir orbital complex in a highly professional manner.

On 28 November 1988, following successful docking of the Soyuz TM-7 spacecraft with the Mir scientific research complex, A. Volkov, S. Krikalev, and Jean-Loup Chretien, together with V. Titov, M. Manarov, and V. Polyakov, proceeded to carry out the scientific program. The new program, although in large measure a logical continuation of the preceding one, contained a greater quantity of research investigation and experiments than the first Soviet-French manned mission flown in 1982, and contained a number of fundamental differences.

For the first time in the history of international manned missions aboard Soviet spacecraft and space stations, a French cosmonaut left the spacecraft and performed an EVA together with a Soviet cosmonaut. Prior to this time only Soviet and U.S. nationals had spacewalked. France became the third country to have a cosmonaut engage in an EVA. During their excursion outside the spacecraft, A. Volkov and Jean-Loup Chretien performed the Era and Obraztsy experiments.

The Era experiment was performed for the purpose of testing the possibility of deploying outside a spacecraft a truss beam structure which in the future could serve as a platform for various antennas or large structures. The hinged truss beam structure, fabricated of carbon-reinforced plastic tube, in undeployed configuration looked like a "bundle of brushwood," but following deployment it assumed the form of a hexagonal prism approximately 1 meter tall and 4 meters in diameter. The truss beam structure was secured to a beam on the mounting platform attached to the handrails on the exterior of the conical part of the transfer module. As usual, during deployment experienced operators duplicated in the weightlessness simulation tank at Zvezdnyy Gorodok the deployment procedures of the crew in orbit.

Upon completion of the experiment, a special system employing a spring mechanism provided capability to jettison the structure on command from the space station control console. That is, the experiment presupposed active participation by the third member of the Soviet-French crew—S. Krikalev. Positioned inside the Mir modular space station, he monitored the EVA checklist, gave commands when necessary, and operated the video recording unit which was linked to the exterior-mounted TV camera. The precise, smoothly-coordinated job done by all crew members and successful accomplishment of this experiment was the result of numerous practice sessions conducted in the weightlessness simulation tank at the Cosmonaut Training Center imeni Yu. A. Gagarin.

The purpose of the Obraztsy experiment was to study over an extended period of time, not less than 6 months, the effect of space (solar, ultraviolet, and cosmic radiation, free hydrogen atoms, dust) on various materials. For this purpose equipment was mounted outside the Mir space station. Experiment results will be analyzed on earth. But this requires that the materials be removed from the station exterior surface by Soviet cosmonauts on the next EVA.

During conduct of the Era and Obraztsy experiments, the cosmonauts wore spacesuits of a semirigid type. They proved quite satisfactory, enabling A. Volkov and Jean-Loup Chretien to remain 6 hours outside the spacecraft.

The Amadeus experiment—testing of a solar panel power unit model—was also unusual. The principle of rolling friction was employed in place of the traditional sliding friction. The experiment was conducted inside the Mir space station and consisted of a series of deployments of the model. This process was recorded with two TV cameras with infrared intensification, onto a VCR

and a system of recording impact on the basis of information from sensors attached to the model.

The joint mission schedule also included a large volume of biomedical experiments. The Ekhografiya experiment, for example, was devoted to detailed study of the state of the human cardiovascular system during space flight. A set of scientific apparatus was installed aboard the space station for this purpose. Ultrasound and Doppler techniques were used to estimate the velocity and nature of vascular blood flow. Images of the heart, large vessels of the body and vessels of internal organs were obtained directly on the VCR display screen. In addition arterial pressure was measured, and environmental parameters were automatically recorded: pressure, temperature, humidity.

The Minilab experiment was for the purpose of studying hormonal regulation of water-salt metabolism in the human organism at various phases of space flight and determination of the interlinkage between the state of the blood circulation system and water-salt metabolism. The cosmonauts used a Plasma-02 system, which provides capability to obtain, process, store and transport specimens of biological material for later biochemical analysis.

The Fizali experiment, a continuation and further development of the Poza experiment, included comprehensive investigation of the system of control of human motion during performance of various types of movements. Specially designed equipment provided simultaneous recording of numerous physiological signals (muscle bioelectrical activity, eye movements, displacements of individual parts of the body). A modern TV stereoscopic filming technique was used to record the spatial position of the body and limbs.

The psychophysical characteristics of human operator activity, using a spacecraft control model, and changes in psychophysical characteristics in the process of adaptation to weightlessness were investigated in the Viminal experiment. A specially designed handle fitted with sensors to record operator actions, connected to the Ekhografiya experiment equipment unit, was used in this experiment.

The Erkos experiment investigated the effect of heavy ions on individual elements of integrated circuits with large-scale integration. The Erkos equipment comprises a separate module, with the irradiated detector card mounted on the rear panel. When installing this unit aboard the space station, it was necessary to place the panel in contact with the station wall.

In carrying out space research programs aboard Soviet manned spacecraft, considerable attention is devoted to crew radiation safety. One piece of equipment carried aboard the Mir space station is used to measure quantity of absorbed radiation dose. The French Circe experiment was conducted for this purpose. It made it possible to obtain new information so essential for increasing the accuracy of estimate of radiation effect on cosmonauts during a mission.

The joint Soviet-French scientific program was successfully completed on 21 December 1988. Now scientists have the job of processing the obtained results.

In coming years, stated A. Dunayev, chief of USSR Glavkosmos, nine additional projects will be carried out with the participation of the USSR and France.

Thumbnail Operational History of Mir Space Station

91441175k Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) p 31

[Article, published under the heading "The Space Program Serving Science and the Economy," by Hero of Socialist Labor Yu. Semenov, corresponding member of the USSR Academy of Sciences, Lenin and State Prize recipient: "Three Years in Orbit"; first part of multiple-part article]

[Text] Modular space stations represent one of the most important trends in the Soviet space program. We associate these stations with basic and applied research, producing genuine economic effect, as well as the development of engineering solutions for future interplanetary spacecraft. The most recent of these stations, the Mir orbital complex, contains a number of fundamental differences from its predecessors.

First of all, its capabilities have greatly increased due to modular design. The Kvant was the first modular add-on. Such an approach to space station design makes it possible to reduce work and space loading on the main component—the core station, and to provide more convenience in operation of onboard equipment and comfort for the crew.

Secondly, the modular space station control system has been fundamentally changed by using final control elements based on powered gyroscopic systems (gyrodynes). This has made it possible to remove virtually all restrictions on fuel stores for conduct of experiments, to achieve highly precise orientation for conducting observations, and to eliminate interference occurring during expelling of rocket exhaust gas.

Third, the Mir is the world's first space station permanently operating in active manned mode. At this point we cannot help but mention our veterans—the Soyuz and Progress spacecraft. It is thanks precisely to these space vehicles that today we are able to relieve crews in the course of a mission without interrupting scientific research activities. And the equipment and apparatus carried aboard the Mir space station provides capability to conduct research in all basic areas traditional for

Soviet orbital complexes: astrophysics, materials science, biology, medicine, biotechnology, remote earth sensing, and technical experiments.

This month it will be three years from the time a Proton booster lifted the core station of the Mir orbital complex into earth orbit. During this time it has docked with seven manned Soyuz spacecraft, 14 Progress freighter craft, and a Kvant astrophysical module. A total of approximately 30 tons of cargo has been delivered.

The first primary or host crew to man the Mir orbital complex—Leonid Kizim and Vladimir Solovyev—performed thorough testing on the core station structural components, debugged, tuned and adjusted onboard equipment, and installed additional instrumentation, that is, fully prepared the station for the next crew. The cosmonauts also transferred to the Mir space station scientific equipment weighing 400 kilograms from the Salyut 7 orbital complex, flying a "shuttle route" aboard the Soyuz T-15 spacecraft, unprecedented in the history of space exploration. In future years flights from a space station to space objects in other orbits will become a routine occurrence. Historians unquestionably will recall the Soyuz T-15 spacecraft and its crew, who made the pioneer flight.

The scheduled program was essentially completed by the second host crew—Yuriy Romanenko, Aleksandr Laveykin, and Aleksandr Aleksandrov, who replaced Laveykin. Over a period of 326 days cosmonaut crew members conducted 1,400 scientific research and experiment sessions aboard the Mir space station, utilizing 75 different pieces of equipment weighing a total of 2,100 kilograms. Syrian cosmonaut Mohammad Faris took part in some of them. In the course of this international crew's mission they imaged Syria and adjacent regions and performed geophysical, industrial, and medical experiments.

The second host crew logged three EVAs. The first was an emergency spacewalk. Its purpsoe was to free the docking assembly of the Kvant module (the EVA lasted 3 hours 40 minutes). Two others (lasting 1 hour 53 minutes and 3 hours 15 minutes) were required to mount on the core station a third solar panel weighing 340 kg. Nobody had ever installed such massive structures during an EVA: the new solar panel's photovoltaic cells covered an area of 22 square meters, generating 2.4 kw. It represented a substantial addition to the onboard electric power system: total power output rose from 7.7 to 10.1 kilowatts.

A third host crew took over the Mir space station in December 1987: cosmonauts Vladimir Titov and Musa Manarov. They performed an EVA in February 1988, installing an experimental solar panel section. The spacewalk totaled 4 hours 25 minutes. The crew performed repairs on the TTM telescope on the Kvant module during a second and third EVA.

An international crew came aboard in June, including Bulgarian cosmonaut Aleksandr Aleksandrov. This crew performed 42 experiments, which continued the research being conducted aboard this space station. As we know, succession is one of the most important conditions for effectiveness of scientific endeavors. A large portion of the work was performed utilizing modern equipment developed by Bulgarian specialists.

A Soviet-Afghan visiting crew boarded Mir at the beginning of September. The results of the jointly-performed research can be used for the practical needs of the Afghan economy.

A Soviet-French mission of relatively long duration constituted a new stage in the evolution of international manned missions. The joint work efforts by these cosmonauts during approximately one month in orbit made it possible substantially to increase the return from the conducted research by collecting statistical data. This should be considered first and foremost part of an aggregate of medical experiments which occupied an important place in the Soviet-French research program.

An elaborate program of technical experiments, especially involving assembly of structures during an EVA, constituted a new step forward. This area of activity is highly promising for the future construction of space stations. The spacewalk by French cosmonaut Jean-Loup Chretien is also of significance from another standpoint—France became the third country to have a national perform a spacewalk.

The third host crew remained aboard the Mir station for 364 days. The aggregate manned-flight time logged by the space station totaled 809 days by the end of the stay by the third host crew.

The Mir space station's extensive potential for adding additional equipment has made it a convenient means of development of joint efforts in the area of international cooperation on a contractual and commercial basis. Specialists from a number of West European countries took part, for example, in developing the equipment installed in the Kvant astrophysical module.

The Mir permanent manned modular space station continues to circle the earth. Cosmonauts Aleksandr Volkov, Sergey Krikalev, and Valeriy Polyakov are conducting research in conformity with a six-month mission schedule. An additional module is scheduled to be launched, which will extend the space station's capabilities. Work aboard the space station this year will be continued by the next, fifth host crew. International crews will be visiting the station.

(To be continued)

Satellite Control and Telemetry Facility Visited

914411751 Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 32-33

[Article, published under the heading "Space Flight Support," by Col V. Gorkov, Candidate of Technical Sciences: "On Earth Watch Duty"]

[Text] Millions of people who today make use of long-distance phone service, telegraph, and television take it only as due and proper that they are served via communications satellites, and most frequently do not even give a thought to this fact. Nor is anybody surprised today when told that satellites help in mineral prospecting, help locate ships in distress, help achieve more accurate weather forecasting, help plot routes on the seas and oceans, help monitor the environment and study the sun, cosmic rays, and stars.... Nevertheless not everybody knows that there exists an organization the employees of which help perform each of the above-mentioned tasks. It is the space command, control and telemetry system (KIK).

The composition and basic principles of organization of its facilities were devised by Soviet scientists in the mid-1950's at the behest of S. P. Korolev. Initially the system provided monitoring and control of individual space vehicles. As the launch schedule picked up, as programs became more complex, and as specialized space systems appeared, KIK grew both technically and organizationally. The number of ground control and telemetry facilities grew. Control and telemetry ships—research vessels of the USSR Academy of Sciences—were developed in order to improve reliability and continuity of monitoring and control of space vehicles. But this was not enough. Airborne telemetry monitoring stations were added in order to expand the radio communications line-of-sight coverage area of the fixed-site KIK facilities.

The KIK today is a highly-organized automated system providing management and control of all vehicles operating in space, unique in its complexity and technical capabilities. There are currently more than 100 space vehicles in operation. At the same time the system lacks a clear-cut territorial integrity, since we are dealing with an organizational-technical concept. The KIK system includes command and control agencies and more than 30 fixed-site and mobile control and telemetry facilities scattered over the territory of the USSR and the World Ocean. The former are responsible for the entire aggregate of activities, beginning with the designing of a space vehicle, while the latter are responsible for the operation of ground facilities and orbital vehicles. Naturally control and telemetry facility engineers and technicians study documentation and conduct training activities in advance, that is, the process of gaining knowledge of new equipment takes place with them exactly as in other branches and sectors of the economy.

This small digression into the history and technology of space flight support activities gives one the opportunity to grasp the fact that the control and telemetry facility is the principal "workhorse," so to say, in the KIK system. It is these facilities which handle direct control of a space flight, monitor flight path and telemetry, receive scientific and applied data, and conduct radio communications with cosmonauts.

In September 1988 I visited a control and telemetry facility situated in the southern part of this country. First of all I noted that the majority of its personnel were young people, recent graduates of higher and secondary schools. I shared my thoughts with P. Meshchenko, one of the facility's supervisors.

"We have varied situations," commented Petr Nikolayevich. "But for the most part these are good people. But rather than tell you about it, let's go and I'll introduce you to our people. A communications session with a satellite will be commencing in an hour. You can look around and talk with people."

And we proceeded toward a structure containing one of the multifunction facilities.

"Over the last several years this department has been one of the best at our facility," Meshchenko told me as we walked. "And in job performance for last year it took second place among departments servicing such systems within the KIK complex. It is headed by Oleg Alekseyevich Slipachenko. He was assigned to us eight years ago, upon graduating from college. Today Slipachenko is one of the facility's top specialists. Calm, composed, and even somewhat mild in personality, Oleg Alekseyevich soon finds common ground with people. He is distinguished by a high degree of professionalism, modesty, kindness, and unfailing willingness to help his comrades, that is, those same qualities which today, during perestroyka, are most needed by the supervisor. But in daily operational matters he has literally nerves of steel. In problem or emergency situations he works swiftly and with initiative. In 1986 the automated control system failed during a communications session. Oleg Alekseyevich did not lose his composure. He immediately took over manual antenna control, working with engineer Andrey Mazanov. The work to be accomplished during the communications session was fully completed. Slipachenko has come into his own here both as a person and as a specialist."

We approached one of the first systems to be incorporated into the KIK automated control system. It consists of a command unit and a radar unit. The former is the most complex and critical. This component is responsible for transmitting one-time commands to a satellite, loading temporary programs, checking and correcting the onboard time system, and generating all control-related commands for the radar component: radar monitoring of orbit, reading of telemetry, or conduct of two-way communications with the satellite.

Two types of commands are generated for satellite control. Commands of one type control satellite orbital motion, while commands of the other type control equipment operation. They are identical in form and principles and differ only in methods of calculation. It is fairly complicated and sometimes outright impossible to control with commands a satellite in low earth orbit, where radio communications line-of-sight is limited to several minutes. This is true, for example, of weather satellites over the World Ocean. This is why programmed control is used in addition to commands.

A program can be viewed as phrases, each of which consists of commands and time which determines the moment of their execution. Rigid and flexible programs are differentiated. The former is generally loaded into an onboard program and timing device when a satellite is being prepared for launch. Only one command is transmitted by radio link, which causes the program to initiate execution. This method of control is the most simple and reliable. A rigid program, however, cannot follow situation change and cannot be corrected once the satellite is launched. A rigid program arrangement can be compared with a record player in which you cannot change the tune without changing the record. It is even more complicated to "change the tune" on a satellite with rigid programmed control: after all, it cannot be returned to earth in order to perform this procedure.

More sophisticated is a method of control by flexible program, which can be completely or partially altered during a radio communications session. Here too there is an obvious analogy. A flexible program is comparable to a magnetic tape recording, which can be replaced at will, completely or in part, without removing the tape. In a flexible program commands and execution time are calculated during satellite flight and are transmitted to an onboard programmed timing device by radio link. Intermediate variations are also possible, when commands can be corrected or changed within certain limits.

Control of satellites is inconceivable without using computers. And computers, as we know, employ binary codes. Therefore a uniform code has been adopted for radio control within the "computer-command source and transmission link" system.

In addition, in order to conduct a several-minutes radio communications session with a low-flying satellite, it is necessary to know precisely where and when it will appear and its subsequent flight path. This information is provided by ballisticians, by computing a satellite's orbital path. This makes it possible to determine at what time and above what points on the earth's surface a satellite will pass. This in turn makes it possible to prepare a work schedule both for satellite-borne and ground equipment, to compute the time at which an orbital vehicle will enter radio communications line-of-sight, and to provide target designation data for transmitting and receiving antennas.

We now invite the reader to form a mental picture of the control room of the system's radar component, where operators will be monitoring the orbit of one of the Kosmos satellites, which is approaching the facility's line-of-sight coverage zone. Along the walls of a comparatively small room stand the equipment racks and cabinets housing the receiving and transmitting gear, search and guidance system, automatic angle measuring equipment, and antenna guidance system. Each equipment station is manned by an operator. A positional coordinates engineer and a sequence timing operator are also on duty. A pennant bearing the title "Best Station Operator" hangs on one of the operator station equipment cabinets. An illuminated display panel is displaying the "Orbit radar monitoring" command code and execution time.

Self-contained and combined checks of receiving and transmitting equipment as well as flight path measurement recording and processing unit have just been completed. With the aid of a radio alignment tower, the system has been made ready for automatic satellite radar acquisition and tracking. A signal indicating that the satellite's duty transmitter is operating appears on the receiving equipment operator's console screen, and the operator reports aloud: "Satellite transmitting, begin receiving."

The sequence timing operator passes on this command to the facility's operations duty officer.

"Acquire for automatic tracking," instructs the duty shift chief.

"We have acquisition," the operator reports.

A sequence of instructions, one after the other, now follow: "Prepare to energize."

"Energize."

"Commence recording data...."

The operators closely monitor the satellite's movement. From time to time I hear an unusual command: "Mark!" What does it mean? I was told that the search and guidance system operator is given a ballistician-computed table of satellite position at key points in its orbital path. As soon as it approaches one of them, we hear this exclamation. It serves as a signal for the timing sequence operator to evaluate the actual and calculated orbital vehicle passage time over these points.

After the communications session was completed, I had the opportunity to speak with O. Slipachenko.

"Oleg Alekseyevich, today's communications session went without a hitch. Have you experienced abnornal situations or incidents which would be of interest to our magazine's readers?"

"Our equipment is reliable, and I cannot recall anything sensational," replied Slipachenko in a not particularly enthusiastic voice. "Incidentally, there is one thing.

There have been cases where for various reasons the communications program has not been completely executed at telemetry monitoring sites along a satellite's flight path, in which case our facility has jumped in, for there are no other ground sites after us."

"Petr Nikolayevich tells me that you were awarded a government decoration and have become an expert at your job. I imagine it was not easy to achieve such excellent results."

"A great deal in our work depends on teamwork. You have seen what high-quality equipment we have. Each individual should work with smoothness and precision with every other member of the team. I was lucky at the beginning of my career. I learned a great deal from my first supervisors, Leonid Aleksandrovich Koshelev and Igor Mikhaylovich Rodionov. Igor Mikhaylovich was extremely hard-working and efficient, possessing excellent methodological skills. One can judge how well he understood the equipment from his efficiency innovation proposals and inventions which we adopted. This man infused us with enthusiasm by personal example both on and off the job. Naturally many of us, including myself, endeavored to emulate our leader. But this required that we constantly study and work conscientiously."

I asked Oleg Alekseyevich which of his colleagues he relied on more than others on the job and who he would single out for particular praise.

"You're putting me in a difficult situation," Slipachenko smiled. "I have just been saying that our equipment is operated by a team, and the team has been indoctrinated on traditions. We live and work according to the principle 'one for all and all for one.' But if you mean people who work in the most difficult areas, I would name first of all Sergey Stanislavovich Gusev, head of the system's command component. The Communists elected him department party organization secretary. He is sociable, shows initiative, and actively assists management in organizing socialist competition in the subunit. Each week we total up performance results, and the top operator is given the pennant you saw. Incidentally, you mentioned abnormal situations. On occasion the control team has had difficulties with determining the reasons why a program has failed to run correctly. Sergey Stanislavovich, together with the chief engineer service people, have time and again helped out on such occasions."

Our interview ended at this point: it was almost time to talk to the next satellite. The operators took their places.

Day and night, in heat and cold, the people of this restless profession stand watch at all facilities. They are the invisible ones behind the data coming in from space. Remember them when you see on the Vremya TV news a report coming across the TV bridge which links the continents.

Listing of Soviet Manned Space Mission Crews

91441175m Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 34-35

[Article, published under the heading "Readers Request," by Ye. Dyatlov and S. Yegupov: "Spacecraft Crews"; first part of multiple-part article]

[Text] Our readers inform us in their letters that they would like to have some summary data on Soviet cosmonauts and their backup crews. They request that we state the crews' radio call signs, specify the number of missions flown by a given space explorer, and provide the date of launch and landing as well as mission duration.

We shall meet their request. We should note that a call sign is assigned to a mission commander on his first mission. The call sign remains the same on all subsequent missions. The other crew members use the mission commander's call sign. In addition, in certain cases a primary crew may have two or more backup crews.

The following materials were prepared by Ye. Dyatlov and S. Yegupov from the Cosmonaut Training Center imeni Yu. A. Gagarin.

Table

Number	Primary Crew	Backup Crew	Call Sign	Spacecraft, Space Station	Date and Duration of Mission
1	2	3	4	5	6
1.	Gagarin, Yuriy Alekseyevich	Titov, German Stepanovich	"Kedr"	Vostok	12 April 1961, 1 hour 48 minutes
2.	Titov, German Stepanovich	Nikolayev, Andriyan Grigoryevich	"Orel"	Vostok 2	6 August-7 August 1961, 1 day 1 hour 18 minutes

Table

Number	Primary Crew	Backup Crew	Call Sign	Spacecraft, Space Station	Date and Duration of Mission
1	2	3	4	5	6
3.	Nikolayev, Andriyan Grigoryevich	1. Bykovskiy, Valeriy Fedorovich; 2. Volynov, Boris Valentinovich	"Sokol"	Vostok 3	11 August-15 August 1962; 3 days 22 hours 22 minutes
4.	Popovich, Pavel Romanovich	1. Komarov, Vladimir Mikhaylovich; 2. Volynov, Boris Valentinovich	"Berkut"	Vostok 4	12 August-15 August 1962, 2 days 22 hours 57 minutes
5.	Bykovskiy, Valeriy Fedorovich	Volynov, Boris Valentinovich	"Yastreb"	Vostok 5	14 June-19 June 1963, 4 days 23 hours 6 minutes
6.	Tereshkova, Valentina Vladimirovna	1. Solovyeva, Irina Borisovna; 2. Ponomareva, Valentina Leonidovna	"Chayka"	Vostok 6	16 June-19 June 1963, 2 days 22 hours 50 minutes
7.	Komarov, Vladimir Mikhaylovich; Feoktistov, Konstantin Petrovich; Yegorov, Boris Borisovich	Volynov, Boris Valentinovich; Katys, Georgiy Petrovich; Lazarev, Vasiliy Grigoryevich	"Rubin"	Voskhod	12 October-13 October 1964, 1 day 17 minutes
8.	Belyayev, Pavel Ivanovich; Leonov, Aleksey Arkhipovich	Gorbatko, Viktor Vasilyevich; 1. Zaykin, Dmitry Alekseyevich; 2. Khrunov, Yevgeniy Vasilyevich	"Almaz"	Voskhod 2	18 March-19 March 1965, 1 day 2 hours 2 minutes
9.	Komarov, Vladimir Mikhaylovich	Gagarin, Yuriy Alekseyevich	"Rubin"	Soyuz 1	23 April-24 April 1967, 1 day 2 hours 48 minutes
10.	Beregovoy, Georgiy Timofeyevich	1. Shatalov, Vladimir Aleksandrovich; 2. Volynov, Boris Valentinovich	"Argon"	Soyuz 3	26 October-30 October 1968, 3 days 22 hours 51 minutes
11.	Shatalov, Vladimir Aleksandrovich	Shonin, Georgiy Stepanovich	"Amur"	Soyuz 4	14 January-17 January 1969, 2 days 23 hours 21 minutes
12.	Volynov, Boris Valentinovich; Yeliseyev, Aleksey Stanislavovich; Khrunov, Yevgeniy Vasilyevich	Filipchenko, Anatoliy Vasilyevich; Kubasov, Valeriy Nikolayevich; Gorbatko, Viktor Vasilyevich	"Baykal"	Soyuz 5; Soyuz 5 - Soyuz 4; Soyuz 5 - Soyuz 4	15 January-18 January 1969, 3 days 54 minutes; 15 January-17 January 1969, 1 day 23 hours 39 minutes; 15 January-17 January 1969, 1 day 23 hours 39 minutes
13.	Shonin, Georgiy Stepanovich; Kubasov, Valeriy Nikolayevich	Shatalov, Vladimir Aleksandrovich; Yeliseyev, Aleksey Stanislavovich	"Antey"	Soyuz 6	11 October-16 October 1969, 4 days 22 hours 43 minutes
14.	Filipchenko, Anatoliy Vasilyevich; Gorbatko, Viktor Vasilyevich; Volkov, Vladislav Nikolayevich	Shatalov, Vladimir Aleksandrovich; Kolodin, Petr Ivanovich; Yeliseyev, Aleksey Stanislavovich	"Buran"	Soyuz 7	12 October-17 October 1969, 4 days 22 hours 40 minutes
15.	Shatalov, Vladimir Aleksandrovich; Yeliseyev, Aleksey Stanislavovich	Nikolayev, Andriyan Grigoryevich; Sevastyanov, Vitaliy Ivanovich	"Granit"	Soyuz 8	13 October-18 October 1969, 4 days 22 hours 51 minutes

Table

Number	Primary Crew	Backup Crew	Call Sign	Spacecraft, Space Station	Date and Duration of Mission
1	2	3	4	5	6
16.	Nikolayev, Andriyan Grigoryevich; Sevastyanov, Vitaliy Ivanovich	Filipchenko, Anatoliy Vasilyevich; Grechko, Georgiy Mikhaylovich	"Sokol"	Soyuz 9	1 June-19 June 1970, 17 days 16 hours 59 minutes
17.	Shatalov, Vladimir Aleksandrovich; Yeliseyev, Aleksey Stanislavovich; Rukavishnikov, Nikolay Nikolayevich	1. Leonov, Aleksey A. khipovich; Kubasov, Valeriy Nikolayevich; Kolodin, Petr Ivanovich; 2. Dobrovol'skiy, Georgiy Timofeyevich; Volkov, Vladislav Nikolayevich; Patsayev, Viktor Ivanovich	"Granit"	Soyuz 10 - Salyut	23 April-25 April 1971, 1 day 23 hours 46 minutes
18.	Dobrovolskiy, Georgiy Timofeyevich; Volkov, Vladislav Nikolayevich; Patsayev, Viktor Ivanovich	Leonov, Aleksey Arkhipovich; Kubasov, Valeriy Nikolayevich; Kolodin, Petr Ivanovich	"Yantar"	Soyuzt 11 - Salyut	6 June-30 June 1971, 23 days 18 hours 22 minutes
19.	Lazarev, Vasiliy Grigoryevich; Makarov, Oleg Grigoryevich	Gubarev, Aleksey Aleksandrovich; Grechko, Georgiy Mikhaylovich	"Ural"	Soyuz 12	27 September-29 September 1973, 1 day 23 hours 16 minutes
20.	Klimuk, Petr Ilich; Lebedev, Valentin Vitalyevich	Vorobyev, Lev Vasilyevich; Yazdovskiy Valeriy Aleksandrovich	"Kavkaz"	Soyuz 13	18 December-26 December 1973, 7 days 20 hours 56 minutes
21.	Popovich, Pavel Romanovich; Artyukhn, Yuriy Petrovich	1. Sarafanov, Gennadiy Vasilyevich; Demin Lev Stepanovich; 2. Volynov, Boris Valentinovich; Zholobov, Vitaliy Mikhaylovich; 3. Zudov, Vyacheslav Dmitriyevich; Rozhdestvenskiy, Valeriy Ilich	"Berkut"	Soyuz 14 - Salyut 3	3 July-19 July 1974, 15 days 17 hours 30 minutes
22.	Sarafanov, Gennadiy Vasilyevich; Demin, Lev Stepanovich	1. Volynov, Boris Valentinovich; Zholobov, Vitaliy Mikhaylovich; 2. Zudov, Vyacheslav, Dmitriyevich; Rozhdestvenskiy, Valeriy Ilich	"Dunay"	Soyuz 15	26 August-28 August 1974, 2 days 12 minutes

Table

Number	Primary Crew	Backup Crew	Call Sign	Spacecraft, Space Station	Date and Duration of Mission
1	2	3	4	5	6
23.	Filipchenko, Anatoliy Vasilyevich; Rukavishnikov, Nikolay Nikolayevich	1. Dzhanibekov, Vladimir Aleksandrovich; Andreyev, Boris Dmitriyevich; 2. Romanenko, Yuriy Viktorovich; Ivanchenkov, Aleksandr Sergeyevich	"Buran"	Soyuz 16	2 December-8 December 1974, 5 days 22 hours 24 minutes
24.	Gubarev, Aleksey Aleksandrovich; Grechko, Georgiy Mikhaylovich	1. Lazarev, Vasiliy Grigoryevich; Makarov, Oleg Grigoryevich; 2. Klimuk, Petr Ilich; Sevastyanov, Vitaliy Ivanovich	"Zenit"	Soyuz 17 - Salyut 4	11 January-9 February 1975, 29 days 13 hours 20 minutes
25.	Lazarev, Vasiliy Grigoryevich; Makarov, Oleg Grigoryevich	Klimuk, Petr Ilich; Sevastyanov, Vitaliy Ivanovich	"Ural"	Soyuz 18-1	5 April 1975, 21 minutes 27 seconds
26.	Klimuk, Petr Ilich; Sevastyanov, Vitaliy Ivanovich	Kovalenok, Vladimir Vasilyevich; Ponomarev, Yuriy Anatolyevich	"Kavkaz"	Soyuz 18 - Salyut 4	24 May-26 July 1975, 62 days 23 hours 20 minutes

(To be continued)

Causes of Pilot Error Analyzed

91441175n Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, Feb 89 (signed to press 11 Jan 89) pp 36-37

[Article, published under the heading "Flight Safety: Specialist Advice," by Lt Col Med Serv V. Kozlov, candidate of medical sciences: "But Is Human Error the Sole Cause?"]

[Text] Following successful completion of a difficult training mission to the range and release from the four-ship element formation for the landing approach, Military Pilot 1st Class Capt M. Briskin commenced his approach. It seemed that the training mission was completed, and the most difficult flying was behind them. However... the pilot forgot to lower his gear.

This resulted in a mishap-threatening situation. What had caused it: pilot gross negligence and poor level of professional competence? Or perhaps the cause lies in some psychological or emotional mechanisms? There are many questions, but there should be one answer, and that answer should be exact. This of course is not easy to do, especially without thorough so-called technical-psychological analysis. Do you frequently witness the following at post-flight critique and analysis sessions? Unfortunately....

Generally error critique and analysis follows an abbreviated or, more accurately put, primitive scheme. If an error was made at a relatively uncomplicated flight phase, negligence and lack of discipline are seen as the causes. Such an approach to analysis of pilot performance is not only superficial but dangerous. First of all because, without establishing the true cause of a mistake, it is impossible to prevent a similar error in the future. In addition, employment only of disicplinary measures fails to produce a substantial result. This is what happened with Captain Briskin. His superiors did no more than give him a dressing down.

And yet analysis of a pilot's actions from the standpoint of psychology enables one to determine the real cause of an officer's mistake. It consists essentially in the following.

A pilot was flying a difficult training mission, which required maximum mobilization of his mental abilities and physiological systems. When the mission was completed and the aircraft broke formation prior to landing, the internal tension relaxed. The pilot relaxed more, however, than the circumstances would warrant, which

was the reason for his error. Psychologists call this state premature psychological and emotional demobilization. As a rule it occurs after completing the most critical phase of a flight.

Errors caused by premature psychological and emotional demobilization are frequent in flying. After completing a mission, for example, the wingman—Military Pilot 3rd Class Sr Lt L. Borisenko—approached dangerously close to the lead aircraft, while Military Pilot 2nd Class Capt O. Dmitriyev was late in applying the brakes during his landing roll, and his aircraft ran off the end of the runway.

Prevention of errors caused by premature psychological and emotional demobilization consists primarily in consciously monitoring and maintaining at an adequate level the activeness of such mental processes as perception, thinking, memory, etc.

Let us examine some other causes of fairly frequently-occurring errors.

As we know, the control process in flying an aircraft contains several phases: information perception, information processing, decision making, and decision execution. Mistakes can occur at virtually any of these phases. Most frequently errors of perception are caused by negative transfer of practiced skill or habit acquired through practice, inadequate pilot ground training and preparation, and the effect of stress. Here are some specific examples.

During conversion training Military Pilot 2nd Class Maj Ye. Filatov flared high, and his aircraft hit down hard. Analysis indicated that the pilot had utilized those cockpit-exterior information characteristics on which he had relied when landing the combat aircraft he had previously been flying. These characteristics proved different on the new aircraft. Nobody had pointed this out to him, however, during conversion training.

Mistakes in maintaining flight parameters can occur when there is a change in the size of an instrument scale on a new and unfamiliar aircraft. When reading the instrument the pilot not only does not look at the entire instrument but does not always even read the exact parameter values. Fully aware of the reading, he merely takes a brief glance at that sector in which he figures the needle should be. If the isntrument size and scale is different, an error is possible when reading the instrument.

One encounters errors of perception connected with choosing source of information. During a midair refueling operation, for example, aircraft commander Maj N. Artemov repeatedly "shook" the bomber. This happened because at the moment of coming up into position, the pilot involuntarily transitioned to position hold on refueling drogue. The conclusion: efforts to increase his proficiency should be directed toward forming skills in combined work with two sources of information—the tanker aircraft, against which he holds position, and the refueling drogue, with which he is about to make probe contact.

Perception errors caused by inadequate pilot proficiency are frequently encountered when there is a change in conditions of perception. For example, pilots who have never before flown nap-of-the-earth or in mountains make serious errors in estimating height above ground and distance to mountain peaks. There have been many instances where pilots have descended to extremely low level without authorization and have been unable to handle their aircraft. In these cases we are dealing not only with indiscipline but also an unobjective assessment of one's abilities and one's ability to meet those requirements imposed by the new operating conditions.

Difficulties with perception can also arise during low level flight when the terrain under the aircraft changes, such as when one is first flying above trees, and subsequently above brush.

General situation evaluation also suffers when stress occurs as a reaction to an abrupt situation complication. When stress occurs one's attention narrows and concentrates on one or several information sources, whereby the most significant signals may not be perceived. The force of stress factors is determined by the pilot's level of proficiency and psychoemotional stability. Errors in processing information are manifested in incorrect situation recognition or assessment. They are most typical of emergency situations. They are caused by inadequate pilot training and proficiency to act in emergency situations, expressed in poor knowledge of the space-time structure of indications of equipment malfunctions and their characteristics.

In the process of flight operations the military pilot develops reactions not only to specific signals but also to their probability structure. Therefore at a given moment he predicts the most probable events, due to which he may fail to take note of a nonroutine phenomenon. For example, Military Pilot 2nd Class Maj S. Kovalev took an abrupt drop in cockpit noise level to mean engine failure. In actual fact the air conditioner had failed. The pilot could not even imagine that a decrease in cockpit noise level could be caused by such an unlikely occurrence. Therefore during preflight training and preparation pilots must be taught probable situations, taking into account commonality of symptoms and indications.

Decision errors are quite varied both in occurrence and causes. When the annunciator message "Hydraulic System Failure" flashed on, Military pilot Maj Ye. Kopetov at first decided to take no action to correct the malfunction. A psychological analysis of this erroneous decision indicated that it had been made on the basis of past experience: the hydraulic system failure annunciator message had repeatedly flashed a false alarm on the aircraft being flown by this officer. In order to prevent mistakes of this kind, pilots are obligated at all times, no matter how many times a gauge or display has given a

false alarm, to check and make sure that no actual malfunction has occurred. Errors in making decisions occur most frequently when the pilot receives indeterminate information.

As a rule pilots make mistakes in the process of executing a decision during the period of conversion-training over to a new and unfamiliar aircraft. This is caused by the negative transfer of habits acquired through practice. The mechanism of their occurrence consists in the fact that individual procedures (switching on, switching over, switching off, etc) are performed against the background of current aircraft flight control activity. Conscious monitoring is minimal, and therefore the pilot performs various actions automatically, as it were. Such errors can be prevented at the conversion-training stage only with conscious monitoring of every cockpit procedure.

Commanders and instructors should always bear in mind that diminished work efficiency caused by incipient illness or fatigue can be the cause of erroneaou pilot actions. Unfortunately instructors do not pay adequate attention to decrease in functional capabilities of a pilot's mental processes and physiological systems. The probability of making mistakes substantially increases as a result, due to slowing down of reaction speed and speed of mental processes.

In summarizing, we should stress that prevention of pilot error is a complicated business, and therefore it should be organized not intuitively but rather on the basis of comprehensive knowledge, including knowledge of psychology.

United States Accused of Chemical, Biological Warfare Plans

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[Article, published under the heading "Today's World and the New Thinking," by Candidate of Physical and Mathematical Sciences D. Leshchenko and Engr L. Chernousko: "Chemical Weapons in NATO Aggressive Plans"; based on materials published in the foreign press]

[Text] *"It seemed that after the signing of the Soviet-American INF Treaty the arms race would be brought to a halt and the hopes of peoples for strengthening of world peace would be realized. The NATO countries, however, are engaged in a feverish search for means of compensating for their lost missiles. As was reported in the press, the United States has even commenced producing a 'supergas' binary weapon. We would like to learn the history of this issue, where chemical weapons have been employed and by whom, what is the threat of chemical warfare today, and how do things stand regarding negotiations on banning these barbaric weapons?" (Maj G. Kazakov, Capt N. Boyko)*

The following article by Candidate of Physical and Mathematical Sciences D. Leshchenko and Engr L. Chernousko answers our readers' questions.

* * *

Chemistry has been serving us for many decades. It has become a regular part of our daily lives. Many industrial processes and manufacture of various products: from fountain pens and medicines to cars and airplanes—are inconceivable without chemistry. But at the same time its capabilities are being used to develop terrible weapons, which the militarists have placed in the service of their aggressive schemes.

Sad Retrospective View

As soon as chemical weapons (we emphasize—a barbaric means of mass annihilation) first appeared, people began seeking ways to ban them. At the turn of the century, in 1899, an international declaration was drawn up in the Hague, on the initiative of Russia, pertaining to banning the use of suffocating gases. It was signed by many leading states, with the exception of the United States and Great Britain. In 1907 a convention was adopted at the Hague, prohibiting the "use of poison or poison weapons."

Nevertheless at the outbreak of World War I these documents did not keep the Western military establishment from the temptation to use this insidious means in an attempt to gain an easy victory. In 1914, for example, French forces began using tear gas grenades, while German forces began using tear-gas-filled artillery shells. The following year Germany turned to more deadly substances: chlorine, phosgene, and mustard gas. Since individual protective equipment did not yet exist, the results were catastrophic. More than 100,000 officers and men died from war gases, and 1.3 million men were disabled.

During the intervention against Soviet Russia, British and U.S. troops employed chemical shells and supplied them to the White Guard armies. Red Armymen and civilians died....

In the 1930's the Mussolini Fascist dictatorship employed lethal gases during the aggressive war in Abyssinia. During the war between Japan and China, 1937-1945, the Japanese militarists ruthlessly poisoned Chinese soldiers and civilians with gases.

Although Fascist Germany had stockpiled hundreds of thousands [sic] of lethal war gases, it refrained from employing them on the battlefield, fearing retaliation by the Allies. Gases were used "sporadically," however, in Poland and the Crimea, as well as on a large scale to kill millions of people in concentration camps.

These facts demonstrate that the employment of toxic chemical agents leads to the mass annihilation of human lives and is downright inhuman.

The Soviet Union and the world's peace-loving forces embarked upon and are tirelessly waging a campaign against these barbaric weapons. A Geneva Protocol banning the employment in war of choking and poisonous gases and bacteriological agents was drafted in 1925. It went into effect in 1928 and was signed by representatives of 26 countries, including the USSR. It took the United States almost 50 years to accede to this Protocol.

"Orange Death"

The aggressive war waged by U.S. imperialism in Vietnam went on for an entire decade—from 1961 to 1971. Cities, towns and villages, thousands of factories, schools, and hospitals were reduced to rubble. For the first time in the history of warfare the United States employed in this war specially manufactured herbicides and defoliants to destroy plant and animal life. The total quantity of employed chemical agents exceeded 100,000 tons. 15 different compounds were tested, until the "most effective ones" were selected. One of them (so-called Agent Orange) contains dioxin—a terrible, lethal poison 1,000 times more powerful than potassium cyanide and more toxic than nerve agents. U.S. military aircraft "sowed" approximately 57,000 tons of this "orange death." This terrible poison attacks the skin, causes paralysis, malignant tumors, and blindness. Genetic consequences are exceptionally dangerous. It is not mere happenstance that horrifying occurrences were recorded in much-suffering Vietnam: children born without eyes, a little girl with stumps in place of legs.... More than 2 million Vietnamese suffered as a result of employment of toxic chemical agents by the U.S. military.

The U.S. barbaric chemical warfare in Indochina was also directed against nature. In South Vietnam alone 44 percent of forests and an equal percentage of cultivated land was treated with defoliants and herbicides. Scientists estimate that it will take more than 100 years for natural recovery and reestablishment of the flatland tropical forests.

According to press reports, these barbaric weapons were also used by the Transatlantic military establishment in Korea, Mozambique, and El Salvador. U.S. partners—Israel and South Africa—have also used these weapons.

It has also been noted repeatedly in the press that the United States possesses the world's largest arsenal of chemical weapons. The U.S. stockpile is estimated to total from 150 to 300 thousand tons, including 55,000 tons of the most lethal types. Scientists calculate that this is enough to wipe out the world population four times over and to make the earth unfit for life.

The Pentagon possesses approximately 3 million artillery projectiles, missiles, bombs, mortar shells, and other munitions for delivery of chemical agents. In particular, the Air Force is equipped with bombs, chemical cluster bomb dispensers, aircraft smoke tanks and airplane spray tanks, with a capacity of from 200 to 800 kg of chemical agent. Their employment by U.S. military forces is legitimated by official field manual, with the statement that at an early phase of a war strikes are to be delivered to the entire depth of the adversary's defense "with the entire package of nuclear, chemical, and conventional weapons." A U.S. Secretary of Defense directive covering the years 1985-1989 states the mission quite frankly: "Be prepared for early employment of chemical weapons." Missions involving the simulated employment of chemical weapons are also constantly being rehearsed at NATO exercises and maneuvers, especially in Western Europe.

Nevertheless the existing lethal chemical stockpile is not enough for the Pentagon. Exploiting the myth of a "Soviet military threat," it is carrying out at a feverish pace a program of large-scale "chemical rearmament" of the U.S. military.

Binary Psychosis

At the end of 1987 the United States commenced the manufacture of new-generation chemical weapons—binary munitions. The new assembly line of death is working at full capacity, and this is taking place at a time when the Soviet-U.S. INF Treaty has gone into effect and when certain progress has been noted in talks on banning chemical weapons, which are currently in their eighth year.

Just what are these weapons? The word binary means consisting of two things. Two nontoxic or low-toxicity components (comparatively harmless, an important factor for storage and transport) are carried in separate containers in an artillery projectile or bomb. Upon firing or impact the wall between the containers breaks and the components mix together and enter into a chemical reaction, forming highly toxic compounds. Even in small doses they have a highly destructive effect on the human nervous system and cause death. Consequently they are intended exclusively to kill people, leaving other objects untouched, in the manner of neutron weapons. Another danger of the Pentagon's "new product" is the fact that, by varying the chemical components, one can obtain totally unexpected types of toxic agents, including ethnic or racially-specific weapons which only kill persons of a specific race. It is not surprising that the racists in South Africa and Israel have fallen prey to this psychosis.

Bacteriological Weapons Have Been Banned, But....

From time to time one hears troubling reports from the United States about continuing projects aimed at the development and testing of biological agents for military purposes. The journal BULLETIN OF ATOMIC SCIENTISTS reported, for example, that appropriations for research "for purposes of chemical and biological warfare" increased by a factor of more than 5.3 just between 1980 and 1984. And here is a revelation which appeared in the WASHINGTON POST: at the beginning of 1988 military authorities announced construction in the Utah desert of a laboratory outfitted with the most modern equipment for developing new types of biological

weapons. It "will make it possible substantially to expand not only the program of research but also testing of deadly bacteria obtained by genetic engineering." These include the disease pathogens causing anthrax, tularemia, encephalitis, and other diseases.

All this sounds like a self-admission, and yet the United States placed its signature on the Convention on Banning the Development, Manufacture, and Stockpiling of Bacteriological (Biological) and Toxin Weapons, which went into effect in 1975. More than 150 states are party to this convention, and the Pentagon should not be ignoring the will and aspirations of the peoples of the entire world.

Nor is Washington's shameful harboring of many Fascist German and imperialist Japan war criminals who had worked on the development of chemical and bacteriological weapons mere happenstance. The nerve gases Tabun and Sarin, developed by German chemists before the war, were also adopted by the U.S. military. The United States also shamelessly continued the research activities of Japan's Detachment 100, headed by war criminal General Shiro Ishii. This secret unit worked on the development of bacteriological weapons and performed monstrous experiments on Australian, British, Chinese, Soviet, and, incidentally, American prisoners of war.

The results of this disgraceful "cooperation" soon became known to the entire world. In 1952 the Chinese newspapers published photographs of bacteriological bombs dropped by U.S. aircraft onto North Korea and northeastern China. Some of them were virtual "twins" of bombs developed in General Ishii's "death laboratory."

Scientists maintain that these weapons are no less dangerous than chemical and nuclear weapons: if a single SAC bomber delivers a strike on unprotected terrain, the effective stricken area from a single average-yield nuclear weapon would total 30 square kilometers, while the figure would be 60 for a chemical weapon and 100,000 square kilometers for a biological weapon! Is it not this "tempting" possibility that so attracts certain Pentagon officials, who are holding for dear life to these inhumane weapons, unable to give them up as is demanded by the Convention?

Two Policies—Two Programs

Delegates of more than 40 nations are in their eighth year of talks at the Geneva Disarmament Conference. The idea of the convention consists in ensuring the destruction not only of chemical weapons on a global scale but also elimination of the industrial facilities for their manufacture.

The negotiations have been impeded time and again by the U.S. side. Recently, for example, the U.S. Secretary of Defense declared that the present U.S. objective is not the ban and total destruction but rather "regulation" of chemical weapons, with only a partial reduction. Another high White House official poses the question: "Will such a convention be beneficial to the United States?"

The Soviet Union takes a fundamentally opposite position. Thanks to the efforts of the USSR, the socialist nations and a number of other countries, a certain degree of success had been achieved at the talks by the beginning of 1986. New impetus was given by a program calling for the elimination of nuclear and other weapons of mass destruction by the year 2000, a program advanced by M. S. Gorbachev. Substantial, specific steps taken by our country are also promoting progress in the talks: in April 1987 the USSR declared that it was ceasing the manufacture of chemical weapons as well as the allocation of funds for that purpose. That same year we opened the doors of a military chemical-warfare facility to the parties to the talks, demonstrating our willingness and readiness to eliminate chemical weapons.

This bold general political action will be further built upon. In order to put an end to Western speculations about an allegedly existing Soviet "chemical superiority," the Soviet Union took an unprecedented step: it announced that its chemical weapons stockpile does not exceed 50,000 tons. In addition, these weapons are to be found only on Soviet soil. Our country has ceased the export of dual-purpose chemicals [chemicals which could be used in the manufacture of chemical weapons].

Important resolutions were adopted at the International Conference on Nuclear Weapons, which was held in Paris in January of this year. The next step is to see that they are carried out.

These are the facts. They convincingly show who is in fact concerned about peace and the security of peoples and who is thinking about his own benefit and for the sake of this is refusing to give up his aggressive schemes.

Improved Artificial Horizon Design Proposed

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[Article, published under the heading "Flying and Psychology," by Engr-Pilot 1st Class Yu. Yakimov: "Looking 'Through' the Artificial Horizon"]

[Text] Approximately 80 percent of airplane accidents occur due to unsatisfactory coordination between the "man" and "machine" subsystems.

The reliability and effectiveness of the "pilot-aircraft" system is laid down at early stages of design and shaping of the information-control environment within an aircraft cockpit/flight deck. The crew is sometimes viewed as merely a transmitting element between instrument information and controls. But substantial studies in

engineering psychology confirm that the pilot cannot fly the aircraft without an integral awareness of the aircraft's location and spatial attitude.

The crew maintains specified flight conditions with the aid of the performance and navigation instruments group. The principal instrument in this group is the attitude indicator or artificial horizon. This instrument provides spatial orientation and makes it possible to fly out of visual contact with the ground.

There exist two basic types of artificial horizon. They are differentiated by method of display or indication of angle of bank. One is defined as corresponding to "looking at the ground from an airplane." The following principle is implemented: the pilot sits in the cockpit and sees angular movements of the horizon bar in relation to the fixed airplane silhouette. The other type is defined as "looking at an airplane from the ground." The observer is on the ground and sees an airplane banking relative to the horizon line.

We shall examine the specific features of perceiving bank indication taking into account the psychology of a person during flight.

In the first instance, determining angle of bank from the moving horizon bar, the pilot is compelled mentally to convince himself that the horizon is stationary and that the airplane is banking, although the airplane silhouette on the instrument is "rigidly bound" to the instrument panel and is frozen in place without any motion.

The mnemonic scheme of displaying a moving horizon line is in conflict with the mnemonics of spontaneous, reflex bank control movements. This tends to cause a motor error: the pilot reacts to the dipping of the artificial horizon line as to banking by the aircraft. This reaction is due to the fact that the direction of displacement of the majority of index marks and controls in the cockpit corresponds to a speed (dynamic) model of flight.

Flight personnel study theory of flight and learn to control the aerodynamic forces acting on an aircraft. It is unnatural for flight personnel to manipulate the horizon line. A short bar on an instrument located close to the eyes cannot replace the panoramic, distant and "infallible" natural horizon.

Displaying angle of bank by "looking at the ground from an airplane" originated in the 1930's when a notion was advanced that it was expedient to display according to the principle of reproduction of an analog of that which the pilot sees from the cockpit. Precisely this idea is implemented in the design of the majority of attitude indicators or artificial horizons used in aviation abroad.

Adoption of an erroneous notion is explained by the fact that the aircraft instrument design engineers were unable in those days to take into account the specific features of the flight image which forms in a pilot. Attempting to duplicate on the face of the attitude indicator a picture of the moving ground and horizon as seen from an airplane cockpit, they felt that a moving horizon bar was an effective method of visualization of flight.

In time it was determined, thanks to thorough engineering psychology studies, that good visualization should "trigger" the entire aggregate of mechanisms of mental articulation which operate during visual flight. In other words the picture should be three-dimensional, with strict conformity of scale, that is, it should occupy an angle of about 150 degrees in horizon and about 125 degrees in elevation. The picture should reproduce displacement of the earth's surface. Only if these obvious (plus many others!) conditions are met can one claim actual visualization of flight, creating a dependably operating effect of presence.

A display whereby the aircraft silhouette itself banks corresponds to a person's natural and accustomed concept of the movement of an aircraft in space.

The image—a notion established on the ground—coincides with the depiction of the aircraft's position and attitude on the display. The picture on the instrument maximally approximates the real picture. In this case the principle of kinesthetic analog is also observed: the pilot senses banking as he enters a bank and sees a banking airplane on the instrument.

Intepretation of received signals presents no difficulties, since the airplane silhouette, just as other indicators, becomes a moving figure on the stationary background of the instrument panel. The pilot controls not the horizon line but rather the aircraft. The mnemonics of display corresponds to the pnemonics of bank controlling actions.

This type of display is incorporated in the majority of artificial horizons used in this country.

Strictly speaking, however, not one of the artificial horizons of currently existing types can claim complete visualization of flight, since information from each of them still requires conscious mental processing. For this reason their degree of sophistication and completeness of graphic representation can be evaluated only from the standpoint of relative ease of control: what type of display lends itself more readily to interpretation?

Outside of visual contact with the ground it is easier to control a moving silhouette, because the airplane "follows the controls." During visual flight the cockpit-exterior natural information component is primary in forming one's idea of spatial attitude, and type of artificial horizon is of secondary importance to the pilot.

Those who support display of the first type ("direct view") argue the convenience of a horizon bar which moves with bank angle with the statement that in this case it is easier for the pilot to transition from instrument to visual flight. In actual fact this is not the case.

During a landing approach the pilot has no time and no way to compare the horizon bar on the instrument with

the natural horizon. Transition from instrument to visual flight takes place in a ragged or indeterminate cloud layer with gradual onset of vertical visibility. As he approaches decision height, the pilot is looking not at the horizon but downward, at the approach lights or ground reference points on the basis of which he more precisely determines his position relative to the runway as regards heading and glidepath.

When the pilot establishes visual contact with the ground, in order to make a decision to land or go around, his visual perception of reference points places lower in the hierarchy all other signals taking part in reflecting the aircraft's position and forming his spatial orientation. As a result a comparison between the anticipated and actual position of the aircraft relative to the runway takes place without comparison of the position of the horizon bar on the instrument with the actual horizon, which cannot be seen anyway in instrument meteorological conditions.

Experiments have proven that when an airplane silhouette which moves according to bank angle is used, pilots in visual and instrument flight do not perform erroneous actions in determining bank and pitch angle. When a horizon bar moving in response to bank angle was used, a 19 percent error rate was observed in visual flight and a 19.6 percent error rate during instrument flight. During instrument flight latent response action time increased by 0.6 seconds.

This is due to the fact that, in using any type of artificial horizon display, a pilot is always controlling the aircraft and himself, not the horizon bar, in relation to which he continuously and consciously monitors his bank and pitch attitude.

In the United States studies are still in progress, aimed at revising the type of bank angle indication on the artificial horizon which is universally employed in that country, which follows the principle of "looking at the ground from an airplane." A manual entitled "Engineering Psychology Handbook for Engineers and Designers," by W. Woodson and D. Conover, suggests that the problem of type of display has not yet been finally resolved, although this display principle has been used for decades now in that country.

Until quite recently the type of attitude indicator display predominant in this country was viewing bank angle "looking at an airplane from the ground."

Attempts are now being made to apply and establish the principle of display adopted abroad. In my opinion it would be more correct to take into consideration both the positive and the negative in the foreign practice, rather than just copying it.

The operating manual for an aircraft with display of the type "looking at the ground from an airplane" explains not the principle of bank and pitch angle display per se but only that which an outside observer might see on the artificial horizon instrument. The manual describes a set of arbitrary bar displacements, on the basis of which it is very difficult to picture the airplane's actual movement. With this kind of display the pilot's orientation to the airplane's attitude is not formed. It is replaced by an image of the horizon bar, which must be "displaced" to the proper point on the scale by manipulating the controls.

Forcing a pilot's attention to monitoring of the position of bars, lines and index marks without an understanding of the overall situation teaches him not to generate a picture of spatial orientation but to "fly by the marks" unthinkingly, which causes passivity of consciousness and is fraught with potential mishap-threatening situations.

In contrast to indication of bank angle, indication of pitch angle is identical on artificial horizons of both types—"looking at the ground from an airplane." But pitch angles are read off a moving scale opposite the aircraft silhouette, as if looking from the ground. Therefore the pilot must fix his gaze twice in determining a single parameter. To draw an analogy with indication of bank angle, we are dealing with a discrepancy between principle of instrument reading and type of display.

The development of electronic flight instruments provided impetus to the search for ergonomic solutions for displaying flight information. A display can be made more graphically clear and understandable by employing the concept of pilot spatial orientation.

During flight a pilot does not control bars, index marks, localizer or glideslope needle, but rather aerodynamic forces and physical processes. Graphic display means not only ease of perception but also conformity between perception and notion of dynamics of the aircraft's movement in space. Therefore one should not evaluate the face of an instrument solely on the basis of speed of perception of index marks or symbols. It is important to determine how this information is incorporated into piloting algorithms, how it supplements and clarifies the spatial orientation picture already existing in the pilot's mind.

The accompanying figure [not reproduced] shows an attitude director indicator which differs from previous instruments of this type in the fact that the bank and pitch angles are read off the same scale. Bank is displayed according to the principle "looking at an airplane from the ground," that is, one determines from a moving aircraft silhouette both the qualitative picture (left, right) and quantitative value of the aircraft's angle of rotation on its roll axis. Pitch is displayed according to the principle "looking at the ground from an airplane": a moving horizon line is used to determine both the qualitative picture (up, down) and quantitative value of the aircraft's angle in relation to its pitch axis.

Bringing the principle of value reading into conformity with type of display eliminates the need to incorporate a special moving scale for pitch angle into the instrument face. This significantly lowers the level of information

interference in determining aircraft attitude and leaves a priority slot for other important signals.

It has been experimentally demonstrated that the only effective mode of displaying aircraft attitude is that whereby on the artificial horizon the pilot sees the ground as stationary, while the pilot and his aircraft remain a moving, controllable object.

A stationary scale will simplify control. Mentally referencing to a clearly represented coordinate system which is stationary in relation to the pilot, the latter will be able more surely to monitor his actions and spatial attitude, and namely his own, not that of the aircraft, because the pilot and aircraft displace in relation to the ground as a single unit. This is based on the geocentric principle of spatial orientation. The two components of spatial orientation are combined only in this coordinate system: spatial orientation and feeling of the aircraft.

Thanks to a visualization thought process, the pilot is able to go beyond the framework of the rigid structure of formal prediction and of determining it, since he subconsciously is taking into account a much greater number of factors. The aircraft controls become an extension of the pilot, as it were. In this case it is more correct to state: picture your own spatial orientation, not that of the aircraft. To picture oneself means "I am flying." To picture the aircraft means "the aircraft is carrying me."

Control with utilization of graphic display of flight information is now regulated not at the level of speech and thought but rather at the sensory-perceptive, associative level. It is governed by sense of touch, by muscular sense and by the system's other auxiliary "automatic controls." The thinking process is busy with overall monitoring and handling the flight's "strategic" tasks.

As he mentally penetrates the external environment via instrument readings, the pilot constructs an inner model of the external world. And the closer this model is to reality, the simpler it is to control the aircraft and the more reliable the "pilot-aircraft" system becomes.

Precision Weapons and Air Tactics Reviewed

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[Article, published under the heading "Into the Military Airman's Arsenal," by Docent Col Yu. Vetrov, candidate of military sciences: "Precision Weapons and Air Tactics"; based on materials published in the foreign press]

[Text] Development and continuous improvement of precision weapons (VTO) is a leading trend in the evolution of weaponry in the military forces of the principal capitalist countries. The term vysokotochnoye oruzhiye is defined as systems which include munitions (missiles, aircraft bombs, projectiles) the flight path of which is adjusted after launch (release) in such a manner as to ensure a direct hit on the target or assured target kill when the warhead explodes. A special group is comprised of missiles (bombs) the warhead of which is filled with submunitions carrying their own self-guidance systems homing them to specific targets, systems which activate after the missile (bomb) enters the area in which the target is located.

In the last decade such weapons have been actively adopted in all branches of service. This has become possible due to successes in developing fundamentally new missile, aircraft bomb, and projectile guidance systems based on utilizing advances in microelectronics, computer, laser, and rocket technology. VTO are in most widespread use in the air forces of the potential adversary.

The current heightened attention on the part of air forces toward precision weapons/precision munitions is due to the following: first of all, an endeavor to increase the effect of airstrikes employing nonnuclear weapons, to bring their effectiveness closer to that of nuclear weapons, and to achieve the concept of combat in which every shot hits the target; second, the need to accomplish missions with small forces due to a steady increase in the cost of modern weapon systems and greatly increased complexity of training flight personnel; third, the need to decrease influence of the human factor on results of weapons delivery in air-to-air and air-to-ground combat; and finally, the desire to make military aviation truly all-weather and capable of operating effectively both night and day.

The development of new weapons has always prompted appreciable changes in combat tactics and has imposed new demands on flight personnel. In the air force this is manifested in increase in range, increase in aspect capabilities, change in parameters and types of attack setup maneuver, modes of aiming, formation forms and characteristics, composition and tasking function of elements and individual aircraft in the overall operational-tactical disposition.

Qualitative transformation of weapon guidance systems is the main factor altering air-force tactics.

As we know, remote guidance, homing guidance, self-contained guidance, and a combination of these methods are used to adjust a missile (bomb) flight path.

The first guided bombs and missiles were equipped with remote guidance systems (radio command guidance or beam-rider). This resulted in a sharp increase in effectiveness of airstrikes. A single aircraft became capable of accomplishing a mission which was beyond the capabilities of a squadron and sometimes even an air regiment [wing] employing unguided weapons. In the war in Vietnam, for example, the Americans succeeded in taking out the Thanh Hoa bridge with a single "smart"

bomb. Prior to this approximately 4,000 sorties had been flown and more than 4,000 bombs had been expended in fruitless efforts to knock out this bridge. Effective range had increased severalfold, and now there was capability to attack a ground installation at standoff range outside the target's air defense zone. Fighters began operating effectively in clouds and at night without searchlight illumination.

In order to attack a target with remotely-guided missiles (bombs), a pilot must continuously observe the target visually or by technical means and hold the pipper on the target up to the moment of impact. This requirement sharply restricts aircraft maneuver capabilities during an attack and reduces an aircraft's capability to penetrate air defense. And in air-to-air combat it increases the effectiveness of fighter-evasion maneuver by the target.

Air-delivered weapons with passive, semiactive, and active seekers (GSN) were developed to overcome these deficiencies.

Missiles and bombs with passive and semiactive homing guidance became the most widely employed by tactical aircraft. Energy radiated by the target (primarily heat or electromagnetic energy) is used in passive homing guidance systems. The aircrew's work when attacking with weapons of this type was much simpler in comparison with employing remotely-guided weapons. To initiate the attack it sufficed to detect the target, determine range to target, and execute proper seeker lock-on procedures. Immediately after launch the pilot could proceed with any maneuver dictated by the tactical situation.

A new mode of attack of air and ground targets began to be widely employed in actual combat and in training, implementing a principle dubbed "fire and forget" by the Americans. But the first air-to-air heat-seeking missiles were highly aspect-limited (attack had to be from the target's rear hemisphere), and there was considerable limitation on fighter and target maneuver G-load at the moment of launch. This led to the search for tactics which avoided such high-G maneuvering: for example, "lead pursuit," "lag pursuit," and a number of others.

According to information in the foreign press, this shortcoming has now been corrected. Recent upgrades of the well-known Sidewinder missile can be aim-fired at G-loads close to maximum allowable G-load on the pilot. But their principal drawback—weapon capability dependence on target characteristics and conditions of flight—continue to reduce substantially the area of employment of such missiles in air-to-air combat and in air-to-ground actions. Heat-seeking missiles can be used only in VFR conditions and only against targets with a significant IR signature. But their effectiveness is greatly affected by the position of the sun, cumulus clouds, hot terrain, and strong sources of thermal radiation (fires, decoy flares). This makes it necessary to select directions of attack which exclude the possibility of "capture" of a heat seeker by the sun.

Missiles with a passive radar seeker can be used only against an operating radar. For this reason, in actual combat operations in Vietnam and in the Near East, supporting measures were widely used in airstrike tactics to destroy SAM system radars, which forced the enemy to switch on his radar at the time required by the attacking force. Such measures might involve launching RPVs and sending out decoy elements and "reconnaissance by fire" elements. Aircraft carrying a mixed ordnance payload were used to hit radars which were switched off after detecting launch of an antiradiation missile. The lead aircraft would attack the target with a Shrike missile, while the wingman, if the radar was switched off, would attack with Bullpup missiles or rockets (bombs), using the Shrike missile's flight path to spot the radar site and select an aiming point.

In order to eliminate the effect of target characteristics on capability to employ precision weapons against it, weapons with semi-active homing guidance were developed, utilizing "illumination" (radar or laser) energy reflected from the target. Air-to-air missiles with such seekers significantly increased effective range and provided all-aspect capability. The concepts of "long-range air-to-air combat" and "close-in air-to-air combat" appeared in fighter tactics. The former presumed "programmed" flight by a fighter, responding to automatic control system commands, to the point where a threat was detected by the aircraft radar, and aimed firing of missiles at long range. Special fighters, which were designated "heavy," began to be designed for this mission. A pilot could fight the second type of air-to-air combat only when the target was within visual range. The preattack maneuver would be set up by visual estimate, based on the relative position of the target. Close-in air-to-air combat is typical of "light" and highly-maneuverable fighters armed with short-range missiles and cannon armament. Close-in combat is fought with G-loads close to maximum physiological limits and consists of standard maneuvers which have been practiced in advance. This type of combat presupposes thorough planning of tactical actions in the process of preparation for a combat sortie.

As "artificial intelligence" systems are developed, standard maneuvers may become the basis for functioning of an "electronic pilot consultant."

Alongside positive attributes, precision weapons with semi-active guidance systems fail to provide capability fully to implement the "fire and forget" attack principle, since the need to illuminate the target restricts maneuver by the attacking aircraft. Division of functions among aircrews is provided in order to overcome this drawback. In particular, a method of attacking a ground target by a pair of aircraft has been devised, with one delivering the strike while the other illuminates the target. The roles then reverse. Another method employed is designation of a special target illumination aircraft. A method is being developed which involves coordination with a forward air controller positioned with ground combat troops and equipped with the necessary gear.

As air weapons became more accurate, the search for ways to employ small groups of aircraft (rotorcraft) and individual aircraft to perform various missions became a leading trend in air tactics. This is due to a sharp decrease in required forces. In the opinion of foreign military experts, this decrease is approximately by a factor of 10 in comparison with operations employing unguided weapons. It is believed that an aircrew employing precision weapons should commence aggressive actions only in the target attack phase. Target coordinates and flight parameters for the attacking aircraft to reach the area of effective employment of precision weapons should be fed into airborne control equipment automatically, from specially-designed automatic control systems. It is considered inadvisable to count on visual search and target detection by an aircrew armed with precision weapons, especially within an effective air defense engagement zone.

Utilization of tactical fighters as components of reconnaissance and strike systems is highly promising. According to this concept, not only would they be brought into the area from which they would launch precision weapons at a detected target, but a weapon's flight path would be adjusted or corrected following release from the aircraft. In order to carry out this mode of strike delivery and to shorten attack time, strike aircraft would be placed on airborne alert during critical periods.

In order to increase the effectiveness of employment of precision weapons, considerable attention is devoted to the conduct of supporting activities, first and foremost air defense suppression and disorganization of the enemy's command and control system. Toward this end the operational-tactical strike force disposition would include supporting elements of various tactical tasking designation (decoy elements, diversion elements, reconnaissance by fire elements, EW elements, etc). Based on the experience of air exercises, the numerical strength of these elements could exceed that of the strike elements by a factor of 3-4.

At the same time a search is in progress for effective modes of autonomous actions by strike elements (target-of-opportunity roving), especially when the command and control system is disrupted. It is anticipated that this mission can be performed most successfully with the aid of promising integrated bombsight, weapons aiming and navigation systems of the Pave Tack type and LANTIRN equipment in combination with precision weapons with semi-active homing guidance.

Fighter aviation is developing modes of combined utilization of fighters of different types—"heavy" and "light"—in air superiority combat. Foreign military experts are considering several variations of conduct of air-to-air combat by mixed-composition elements. For example, an element of "light" fighters could be used as a decoy element, its maneuver calculated to ensure that the enemy, having initiated pursuit, will unavoidably come under "heavy" fighter attack. In another variation the "heavy" fighter would be used as leader. It would attack a threat aircraft at long range, break up the enemy's formation and compel the adversary to execute a defensive maneuver, after which the "light" fighters would engage. "Heavy" fighters armed with weapon systems providing capability to fire simultaneously at several threat aircraft are considered most effective in such combat.

With the appearance of precision weapons, in air-to-air tactics there has occurred a reevaluation of the significance of fighter-evasion and missile-evasion maneuver. In present-day conditions it is virtually impossible to thwart the attack of a fighter armed with air-to-air missiles by maneuvering, even with high G-loads. At best one succeeds in reducing range of effective fire. Therefore the importance of missile-evasion maneuver is becoming greater. It has been established in the course of tactical exercises and actual air-to-air combat that uncoordinated turns with considerable skid (such as a roll with a large radius) and maneuvers with alternating between positive and negative G's are the most effective types of missile-evasion maneuver.

The role of electronic warfare has increased substantially in air tactics with the development of precision weapons. In the opinion of foreign military experts, EW in the air force has changed from a category of combat support to an independent component part of combat operations, air-to-air and air-to-ground combat. As much importance is being attached to equipping modern aircraft with EW gear as to arming them with precision weapons. Modes of employment of EW gear at various phases of a combat mission are being developed. The crew of a modern strike aircraft, in order effectively to employ precision weapons, must skillfully utilize jamming assets in order to penetrate air defense during all phases of a combat mission. A fighter pilot should possess a solid mastery of all methods of protecting his control system, aiming devices and missile seekers against hostile ECM.

Foreign military experts, noting an overall substantial increase in the combat capabilities of aircraft to accomplish primary missions by employing precision weapons, at the same time note a number of specific features of these weapons which one should take into account when devising air-to-air and air-to-ground tactics.

Fairly rigid requirements on conditions of employment of precision weapons (pertaining to type of maneuver and flight parameters to enter the target engagement area) contain the threat of predictable pattern in combat operations and enable the enemy to predict with a high degree of probability the route, flight configuration, and direction of run on target.

The high cost of precision weapons compels the use of these weapons chiefly to destroy maximum-importance targets, while destroying other targets with unguided bombs and rockets. This leads to the necessity of having strike forces contain aircraft with different ordnance payloads.

Nor have hopes of reducing requirements on training flight personnel and on decreasing the influence of the human factor on results of weapons delivery panned out.

On the contrary, employment of precision weapons increases an aircrew's work load at certain phases of a combat mission. In connection with this there is gradually appearing a trend toward designing and building two-seat strike aircraft (tactical fighters and ground-attack aircraft).

And, finally, the high cost of precision weapons presupposes the necessity of detailed calculation and planning of each combat mission and a substantial expenditure of manpower and resources for supporting a strike element.

All this is leading to intensive tactics studies. The French journal DEFENSE NATIONALE notes: "...It would be premature to attempt fully to predict the specific features of conduct of combat operations with employment of precision weapons in the year 2000, but we must today commence giving thought to this."

A thorough study by flight personnel and tactical air controllers of foreign trends in development of aircraft and weapons, air-to-ground tactics, and tactics of air-to-air combat with employment of precision weapons is an essential condition for further increasing the combat readiness of the Soviet Air Forces.

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